

PREFACE.

THIS little book is principally a compilation and adaptation from several valuable English works on the subject. The author has spared neither time nor labour to render the whole subject adapted to the peculiar circumstances and wants of the people of this country, and to present it in an interesting, and, at the same time, a simple form suited to the comprehension of the class of readers for whom the book is especially intended.

The portion of the book which is printed in large type, being simpler and easier than the remaining portion, is particularly intended for the use of juvenile readers, and this portion is published separately in the form of a much smaller book.

In the compilation of this work the author is especially indebted to the valuable works of Drs. Parkes, Pavy, Strange, Ward, and Cornish.

The substance of the greater part of this work has, during the past few years, appeared in several of the vernaculars of the Madras Presidency. The author feels it his duty to avail himself of this opportunity to express his deep sense of gratitude for the very kind and favorable reception the vernacular editions have met with from the public, and for the most generous patronage bestowed upon them by the Madras Government.

W. E. D.

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THE ELEMENTS OF HYGIENE.

CHAPTER I.

INTRODUCTION.

THAT bodily health is the first and the greatest of all earthly blessings, and ill-health the worst calamity that can befall one, are indisputable truths. When the digestive organs by which the food we take is converted into nourishment,—when the heart and the blood-vessels by which the blood derived from food is conveyed to every part of the body,—when the organs of respiration which purify the blood by means of the air we breathe,—when these and other organs of the body remain entire and sound and perform their respective functions regularly and smoothly, no uneasiness or pain is felt, and we are enabled to enjoy life, and to discharge efficiently the various duties devolving upon us. Such a condition of the body is called health.

2. Various causes often impair or destroy this healthy condition of the body and give rise to many diseases and miseries. The Lord of the universe has ordained certain laws relative to health. It is His appointment that so long as we acquaint ourselves with those laws and regulate our life in accord-

ance therewith we should enjoy good health ; but that when we neglect or violate them, our health should be impaired and various diseases developed therefrom. For instance, should a man eat food in immoderate quantities, or should he eat such things as are unsuited to his constitution, his digestive organs will unquestionably sustain injury ; or should he allow himself to be the subject of excessive cares and anxieties or indulge in too intense or too prolonged application of the mind his brain, the seat of his intellectual powers, will certainly be injured.

3. A violation of the laws of health is not always attended with immediate evil consequences. Children who have not been carefully brought up by their parents, and young men who have imprudently dissipated their youth, may for a time appear strong and healthy ; but as they advance in years, the seeds of decay and disease, sown in their early life, spring up and bear their natural fruit in the form of various diseases, premature old age, and untimely death. For instance, young men, who reckless of their health have dissipated their youth in vicious habits, will exhibit the feebleness and decay of old men of sixty before they arrive at their thirtieth year ; while those, who early formed good habits, and always attended to the laws of health, have been thereby enabled to retain all the strength and vigor of young men of thirty even after they actually passed their sixtieth year.

4. It is generally by their own ignorance and

sometimes by their own folly and fault that men lose their health and bring upon themselves diseases. . It is true that some unfortunate people do inherit diseases from their parents ; but then such parents, in very many cases, have first produced those diseases in themselves by their own ignorance and violation of the laws of health and transmitted them to their unfortunate offspring. It may be however urged that even some those who carefully observe the laws of health fall victims to infectious and epidemic diseases. But in such cases it must be remembered that it often happens that diseases, originating from filthy centres about the dwellings of the ignorant and of the poor, spread thence in the form of epidemics until they reach the abodes of the affluent and the noble and thus involve all in a common disaster. Consequently, attention to everything that may conduce to public health becomes the duty and interest of all classes of the community. It is the interest of the rich who fall victims to diseases bred in the filthy and neglected habitations of the poor ; it is the interest of the labouring poor to whom health is but a synonyme for wealth and sickness and premature death for poverty, embarrassment and destitution. So intimate is the inter-dependency of all classes that one class cannot permit the misery of another with impunity.

5. A certain gentleman who had devoted much attention to the study of the human constitution and the laws of health had a rather ignorant brother living in a town. On one occasion when he visited his

brother and inquired after the health of his family he received the following answer : " Although this house appeared at first to be a good one and cost us an enormous sum of money yet we have now found by experience that it does not suit us at all. We do not know whether this misfortune is to be attributed to the evil hour at which we entered the house or to anything else. It is a painful fact that ever since we came into this house there never was a day in which the physician was not called to see us. Sometime ago my wife was struck with paralysis and it was feared that she would permanently lose the use of her limbs. There are but few days on which I am free from a headache or cold. My children are subject to frequent attacks of diarrhoea and dysentery. And as you know last year a peculiar malignant fever attacked almost every member of my family and two of my dear children and a servant fell victims to it. Whether we shall ever be free from these misfortunes I do not know." On hearing this story from his brother, the learned gentleman looked around for the causes of these misfortunes and at once discovered that his brother's house was situated on a lower level than the adjoining buildings, that the floor of the house as well as its walls were damp, that the house was ill-ventilated and kept in a filthy condition, that there was a cess-pool and a dung-hill close to the building, and that the offensive smell from an adjoining drain which was reeking with filth was intolerable. He then replied to his ignorant brother

thus : "The calamities you complain of are not to be attributed either to your bad luck or to the hour at which you entered this house; but are due entirely to your own ignorance and to your having grossly violated the laws of health. If your house and its surroundings are allowed to remain in this condition, the real wonder is why worse calamities have not befallen you. So long as you will remain in this house you may depend upon it that you will never be free from sickness and sorrows." The ignorant brother, quite surprised to hear this, said : "If what you say is true I will quit the house to-morrow. But I am afraid our misfortunes will follow us wherever we may go. Who can avoid the decrees of Fate?" To this the wiser brother replied, "It is only the indolent and the ignorant that ever plead Fate for every thing. Although man is everywhere subject to afflictions and trials still it is our duty not to bring upon ourselves mischief by our own imprudence but to guard against evils by every reasonable means. God in the fulness of his wisdom has ordained certain laws for the regular course of every thing in this world and for the guidance of man and so long as these laws are duly observed all goes well, but whenever they are violated disorder and confusion must and will follow. This is the Fate appointed by God and nothing else. In the same manner there are laws ordained in respect of our health which will be promoted or impaired according as they are observed or broken. I know that you have violated the laws

of health and that all the evils you have complained of have been simply the just reward for your imprudence." By such wise observations he at last prevailed upon his brother to leave his house for a better one situated in a more healthy locality and induced him to observe the laws of health, and the result was that within a short time the newly enlightened brother and his family rapidly improved in health, all their former complaints gradually disappeared and they lived for many years in the enjoyment of sound health and happiness. This anecdote illustrates clearly the good results attending the observance of the laws of health and the evils arising from their neglect and violation.

6. From the foregoing considerations it becomes imperatively necessary that every one should in a measure acquaint himself with the laws of health, practise them himself and induce others also to do the same. Unless the vast amount of ignorance, that at present exists among the masses of the native population as regards the laws of health, is removed by some adequate means, the well-meant schemes and exertions of the Government sanitary officers to promote public health in this country will be attended with very limited success. It is therefore earnestly to be hoped that the young readers for whom especially this little book is intended will acquaint themselves with the leading principles of the laws of health as laid down in the following pages and put them into practice as far as it may lie in their power

thereby contributing towards the diminution of diseases and miseries among the native population.

CHAPTER II.

AIR.

7. Air is indispensably necessary for the existence and continuance of animal life. The first thing we do as soon as we are brought into the world is to take in air by inspiration and the last thing we do when seized by death is to give out the air inside by expiration. We may continue to live for at least a short time without any food at all but our life will cease at once if we do not respire air even for a few minutes.

8. Atmospheric air surrounds our earth to a height of about forty-five miles. Air in motion is called wind. Air consists of two elementary gases, named Oxygen and Nitrogen. Oxygen is the most important element of the two. It is a lively active gas and has a strong tendency to combine itself with many things and burn them up. It supports animal life and combustion. If the atmosphere be deprived of its oxygen, every living being will at once be destroyed and lamps and fires extinguished. We can very easily prove how indispensably necessary is oxygen for animal life and for the burning of lamps and fires. If we invert a good-sized glass jar over a small

bird and another over a lighted candle and prevent the bird and the burning candle from getting any new air from without by making the glass jars air-tight, the air or rather the oxygen of the air inside the jars will soon be used up and then the bird will die and the candle go out simply from want of oxygen to support them. But if we do not make the glass jars quite air-tight but allow the bird and the lighted candle to get a little fresh air from without, the bird will not die but will look sickly and weak and the candle will not go out but will burn dim and weak. Air contains one part of oxygen and four parts of nitrogen. If the atmosphere consisted entirely of oxygen, animals would have their lives very much shortened and would soon die from over-stimulated and accelerated respiration and a fire kindled in one spot would rapidly spread on all sides and the whole world would soon be in a blaze. Therefore, in order to dilute oxygen which is so highly stimulating the all-wise Creator has made the atmospheric air by combining one part of oxygen with four parts of nitrogen which is rather an inactive gas, something as people dilute brandy with water to make it less strong.

9. Air which is made up of oxygen and nitrogen, contains also various foul gases and impurities derived from various sources. We shall now consider some of the most important of these atmospheric impurities.

10. *Carbonic Acid*.—The greatest and the most

important impurity of the atmosphere is carbonic acid. This gas is constantly present in the atmosphere of every part of the globe. Air contains carbonic acid in the proportion of four in ten thousand parts. But this gas is more abundant in the atmosphere of large and densely populated towns and districts. The principal sources of carbonic acid are the respiration of animals, the exhalation from their skins, combustion of charcoal and other carbonaceous substances, vegetation and putrefaction.

11. The chief source of carbonic acid is the animal body itself. Carbonic acid is formed by the combination of oxygen with carbon. When animals take in air by inspiration the oxygen of the air enters the blood in the lungs, purifies the dark impure blood, rendering it bright-red and vivifying, then it circulates with the blood through every part of the body, combines chiefly with the carbon of the worn-out matters of the body throughout the system and burns it up like fuel. It is this burning up of the waste products of the body that generates the poisonous carbonic acid as well as the animal heat which is felt all over the body. Thus a single grown up man generates about 636 grains or nearly $3\frac{1}{2}$ Rs. weight of carbonic acid in a single hour and gives out from his lungs alone from 12 to 16 cubic feet of the gas in 24 hours. We have before noticed that the ordinary atmospheric air contains four volumes of carbonic acid in a ten thousand, whereas respired air contains one hundred times more of the gas, that is, it contains 400 volumes of it in a ten thousand. Besides the lungs, the skin of living animals exhales a considerable quantity of carbonic acid.

12. The next source of carbonic acid is combustion of carbonaceous substances such as charcoal, wood, and oil. The burning of lamps and other lights and fires of all kinds pro-

duce an enormous quantity of carbonic acid. Thus the combustion of a pound of oil generates nearly as much as 10 cubic feet of the gas.

13. Another source of carbonic acid is vegetation. During the night time and at certain stages of their growth (germination and flowering for example) trees, shrubs and vegetables emit large quantities of carbonic acid.

14. Putrefaction of animal and vegetable substances is another cause of carbonic acid. This gas constitutes 16 per cent. of the emanations from sewage and sometimes 2 or 3 per cent. of sewer air. The atmosphere of burial grounds and of marshes contains large quantities of carbonic acid.

15. Carbonic acid is a deadly poison. While oxygen is the supporter of animal life and of combustion, carbonic acid extinguishes them both. If carbonic acid be collected in a vessel and a small animal put into it, it will at once be killed. Sometimes this gas collects itself at the bottom of deep wells and when men incautiously get down into them they are in danger of being killed. In order to ascertain the presence of the gas in such wells, a lighted candle is let down into them and, if a considerable amount of the gas be present, the flame will at once be extinguished.

16. When a large number of people are crowded together in a room and lights are burning in it, carbonic acid is generated largely and the inmates in consequence experience more or less of oppression, head-ache, giddiness and other unpleasant symptoms and they long to leave the room as soon as possible and when they get out and breathe the

pure air outside, their uncomfortable sensations disappear and they feel at once refreshed and cheerful.

17. Those who have read Indian History will remember the horrors of the Black Hole of Calcutta which took place in 1756. About 146 Englishmen were brutally forced into a room about 18 feet square at 8 o'clock in the evening. In a few minutes profuse perspiration broke out from their bodies and the poor unfortunate men began to experience an intolerable thirst and to suffer dreadful agonies. Before day-break 123 of the men died. This was caused by carbonic acid and other noxious emanations from the skin and lungs of the men themselves.

18. Some years ago an accident took place in Madras. It was a very cold night during a rainy season. A Brahmin and his wife went to bed in a room having previously closed the door and windows and carefully secured every hole and crevice in the room by means of rags thrust into them and placed a chatty of burning charcoal at the foot of their bed. At midnight some of the Brahmin's friends that were outside wishing to awake him for some purpose knocked at the door for a long while but received no answer from within. Their suspicions were roused and they immediately broke open the door and found to their great astonishment that the Brahmin and his wife were quite insensible and apparently lifeless. A European doctor was at once sent for who directed the man and his wife to be taken out of

the room and exposed to the fresh air outside and employed some other remedial means. But he was only fortunate to revive the man as the life of the woman was beyond the reach of all human aid. From this accident it is easy to understand the highly poisonous character of carbonic acid which was in this case produced by human respiration and combustion of charcoal.

19. It may be remarked by some that if the comparatively small amount of carbonic acid produced by the respiration of one or two persons and by the burning of small fires should poison the air to such an extent and be attended with such fatal results, how is it then that the enormous quantity of the gas, produced by the respiration of the countless myriads of human beings and lower orders of animals spread over the surface of the earth and by the burning of all kinds of lights and fires in every part of the world, does not in a very short time poison the entire atmosphere and destroy every living being on the face of the earth. But the wisdom of the Creator which is manifested in all His works is beautifully evidenced in this matter. He has ordained that carbonic acid produced by animals should be the natural food of plants. While the animal world consumes oxygen and evolves carbonic acid, the vegetable world which also has a respiration of its own, consumes carbonic acid and evolves oxygen; and the quantity of oxygen consumed by the one is so exactly equal

to the quantity produced by the other that the normal condition of the atmosphere is always maintained without the slightest variation.

20. If the animal world were to consume more oxygen than the vegetable world produces, the necessary consequence would be that the proportion of oxygen in the atmosphere would be gradually diminished and finally exhausted and the animal world would cease to exist. If, on the contrary, the vegetable world were to produce more oxygen than the animal world consumes, the proportion of oxygen in the atmosphere would be continually augmented, animal life would be unduly stimulated, a state of unhealthy intoxication would ensue, which would abridge the duration of life of all species of animals and at length extinguish the animal kingdom as effectually as would the total absence of oxygen. Although the respiration of vegetables produces, on the whole, a supply of oxygen to the atmosphere, this production is not continuous or incessant. During the day and under the stimulus of light the leaves of plants absorb carbonic acid, and decompose it dismissing the oxygen and incorporating the carbon with their own substance; during the night, however, the necessary stimulus of light being removed, the absorption of carbonic acid is discontinued and on the contrary that gas is emitted but in very much less quantity than that in which it was absorbed during the day. The absorption, therefore, on the whole, greatly predominates over the emission so as to maintain, as above stated, an equilibrium in the constituents of the atmosphere. It may be useful to observe here that the circumstance just mentioned of plants emitting carbonic acid at night renders them unhealthy companions in or near our bed-rooms. On the contrary, during day, their presence has a tendency to improve the atmosphere of rooms by absorbing carbonic acid produced by respiration and repla-

cing it by a corresponding volume of oxygen. Persons who love flowers should therefore keep them in their rooms only during the day, being careful to have them removed after sunset.

21. The next common impurity of the air we breathe is sulphuretted-hydrogen. This gas is most offensive to the smell while carbonic acid possesses no smell at all. Sulphuretted-hydrogen is one of the chief products of decomposition or putrefaction of animal and vegetable substances containing sulphur. Hence its free evolution from drains, gutters, stagnant refuse waters &c. It is a highly poisonous gas. In large doses of inhalation it kills animals by suffocation; in smaller doses it produces head-ache, giddiness, loss of appetite, vomiting, diarrhoea, prostration of strength &c.

22. When it was once collected in a vessel and diluted with 1,500 times its volume of pure air and a sparrow introduced into the vessel containing the gas thus diluted, the bird at once became insensible, vomited and died within 15 minutes. Some years ago an accident took place in Madras. When two of the coolies, who were employed to clean the public drains, opened the trap closing the entrance of one of them and incautiously got down into it, they were at once suffocated and fell down insensible and were picked up lifeless. These unfortunate men were poisoned chiefly by sulphuretted-hydrogen gas which had existed in a concentrated form in the long closed drain.

23. Besides carbonic acid and sulphuretted-hydrogen, there are other noxious gases and emanations which, originating from various sources, equally contaminate the atmosphere and endanger health and life.

24. When people neglect to keep their houses clean and tidy and allow their surroundings to remain in a filthy condition, they give cause for the generation of foul gases and emanations which will injure their health. Every one knows in what a wretched condition the ignorant portion of the people of this country keep their houses and their neighbourhood. How many instances we see daily of houses in which the floors, the walls, articles of furniture, utensils, cookrooms, bathrooms, latrines, house-drains &c. are kept in a most dirty, disorderly and disreputable condition! The vicinity of too many houses in towns and villages is nothing but the repository of plantain leaves rejected after meals eaten out of them, of refuse vegetables and fruits, of scales and washings of fish, and of torn shoes, dirty rags, broken earthenware, straw, rice, curry, night soil and dirt; the whole perhaps lying undisturbed for days and weeks together (at least wherever the municipal influence does not reach) and having no chance of a clearance till some festival fortunately occurs when only a sense of decency induces the house-owners to cause their removal at the cost of a few annas. Then again stables, cow-stalls and poultry godowns are

very often either within houses or too close to sitting or bed rooms. How many instances are met with of collections of stagnant and putrefying waste fluids too near human dwellings and of drains, reeking with filth and often made into receptacles of filthy deposits, running too close to houses and often almost surrounding even the mansions of wealthy natives! What is the result of all these irregular, senseless and mischievous practices? It is simply the generation of various foul and noxious gases and emanations which must contaminate the air within and without our houses and charge it with the seeds of destruction.

25. It is therefore absolutely necessary that cleanliness and purification of the air within and without our dwellings should be promoted in every possible way—by a free supply and use of water, by proper house drains communicating with the general sewers or public drains, by careful removal of waste fluids and refuse vegetable and animal matters, by periodical emptying of dust-bins and other receptacles of sweepings &c. while cesspools, stables, cow-sheds, poultry godowns and other sources of foul emanations should not be allowed to be in immediate proximity to our dwellings and they should further be kept dry and clean by effective roofing, gutters, pavement &c.

26. We have glanced at the different sources of atmospheric impurities within and without our dwellings and seen how the gaseous emanations from these, diffused through the air when inhaled and absorbed, become the fruitful sources of

disease and close allies of pestilence. Those therefore who neglect attention to their removal, may be said literally to court disease and death in themselves and to countenance the wholesale destruction of their fellow-creatures. It is true there are sources of pestilential and epidemic diseases (such as cholera) in the atmosphere, which show themselves either constantly or periodically and are beyond our control.

27. But, whatever obscurity may hang over the nature of cholera and other epidemics, there is one undoubted fact connected with their history, viz., that their virulence and fatality are materially affected by causes over which we have complete control. Neglect of the conditions necessary to health, in the individual or community, is found to be the most prominent pre-disposing cause of such diseases. The squalid, the badly or imperfectly fed and especially the intemperate, are those who most readily fall victims to cholera which commits its most fearful devastation in low, damp, ill-drained districts, in densely populated, ill-ventilated, filthy quarters, in the vicinity of foul sewers, stagnant ditches and other sources of impurity. Localities in which it once raged and which were subsequently well drained and purified were found to enjoy more or less immunity from it afterwards. It is indeed only by reference to such causes that we can explain the fact that in some districts the people have died by thousands, while in others not far distant the inhabitants have been unusually healthy. We may certainly consider cholera, in one sense at least, as a chastisement for neglect of laws unmistakably indicated and which Providence has wisely imposed as the present conditions of our health and well-being.

28. The effects of breathing an impure atmosphere are to be looked for not so much in the production of definite and specific diseases as in loss of appetite, loathing of food, low spirits, an impaired and enfeebled condition of both body and

mind, shortened duration of life, and higher rates of mortality.

29. All the food taken into the stomach and there digested must be exposed to the action of oxygen in the lungs before it becomes perfect blood. We may infer from this fact that food and respiration must correspond. The resident of towns, the sedentary and the invalid, who cannot take much exercise or expand their lungs to the full extent or respire pure air, must be content to eat less food and to derive less benefit from the food taken, than the more happily circumstanced countryman who not only breathes plenty of air all day but also receives it in a state of purity and who is obliged to have enough of bodily labour to earn a livelihood in order to maintain himself and his family.

30. Whenever a due supply of oxygen is denied to the lungs, whether from disease of those organs or as most commonly happens from deficiency of pure air in ill-ventilated houses, the worn-out and effete matters which ought to be constantly thrown out of the system are to a greater or less extent retained in the body. It is to this retention of effete matters in the system that the habitual want of appetite, nausea and even loathing of food, are due. The effete matters being retained in the system, there is no room for the deposition of nourishing materials derived from food. The clogging or stoppage of one wheel involves the disarrangement of the next and so on until in the highest degree of disturbance the whole vital machinery is brought to a standstill.

31. The depression of spirits, caused by inhaling an impure air and by want of exercise in the open air, is productive of much moral evil and very often induces habits of drunkenness. Pure air and bodily exercise invigorate men, render them cheerful and active and enable them to discharge their various duties efficiently. But men, living in ill-ventilated

houses and in localities abounding in foul emanations, bring upon themselves an amount of bodily and mental depression which renders them quite unable to pursue their various avocations with anything like energy. Hence these people are led to have recourse to stimulants and intoxicating agents in order to keep up their spirits for a while and they act exactly like the man who would uphold, by means of a wooden prop, the wall which, weakened in its foundation, threatens to fall down. But the intoxicating agents afford exhilaration of spirits which can last only for a short time and their after effect is certainly to bring upon their victims bodily and mental depression far greater in degree than the previous stimulation. It often happens that when persons addicted to drink remove to healthy localities where they can breathe purer air and have plenty of bodily exercise, they are enabled to get rid of their evil propensity without any very great resolution on their part.

32 If we examine carefully the registers of diseases and deaths kept in different countries and in different parts of the same countries, we will be struck with the vast difference, in the duration of life and in the rates of mortality, between large and densely populated towns (whose inhabitants inhale atmosphere more or less vitiated by foul gases and emanations) and rural districts where the more happily circumstanced countryman breathes plenty of air in a state of purity. The mortality per 1,000 inhabitants of large cities (such as London, Calcutta, Bombay and Madras) has been found to range between 25 and 35, whereas the average of mortality in healthy rural districts has not exceeded 17 per 1,000. In other words, the death-rates in large towns are nearly double those in healthy country places. As an illustration of the above statement we may consider that in a city like Madras containing about 500,000 inhabitants, nearly 20,000 people die annually and of this number about half (10,000) is over and above the number of deaths in a year in healthy rural dis-

tracts containing the same number of inhabitants. It has been further proved that the great excess of mortality in large towns over the average of the country is due entirely to the prevalence of zymotic diseases, that is, diseases such as fever, cholera, diarrhoea, dysentery &c. all of which are, in the eye of the sanitary reformer, preventible, seeing that they admit of indefinite mitigation whenever the laws of health are studied and sanitary precautions used efficiently.

Ventilation.

33. As the atmosphere is constantly contaminated by impurities derived from various sources, it would become very soon quite unfit for the purposes of animal life if adequate provisions have not been made to bring about a constant atmospheric change and purification. We shall first consider the admirable means provided by nature for the change and purification of air.

34. *The Law of Diffusion*—The first and most important of nature's provisions consists in the law of diffusion of gases. This law provides that, whenever two gases meet, a mutual interchange of particles shall take place between them. The light and the heavy, the acrid and the poisonous, the pleasant and the innocuous readily intermingle. By this law of diffusion, collections of foul air, noxious gases, vapours and emanations are dispersed and made to find their way readily into the surrounding atmosphere and become more or less intimately blended with it. Were it not for this beneficent arrangement of nature many parts of our towns, many beautiful country districts, where the air moves slowly, would be totally uninhabitable and could not be approached without instant death. The permeating power of atmospheric air prevents any foul gas from accumulating in any place to any actually poisonous degree.

35. *Heated Objects*.—Different objects on the surface of the earth, according to their radiating power, throw out the heat

derived from the sun and, in so doing, heat and rarify the air in contact with them, cause it to ascend and thus tend to promote its renewal.

36. *The Winds*.—The winds are great promoters of external ventilation. These, in proportion to their violence, sweep before them the impurities with which the air may be charged, cause an effective change of air and are especially serviceable in maintaining its purity and healthfulness in crowded towns.

37. *The Vegetable Kingdom*.—Plants, as we have already noticed in sections 19 and 20, purify the air by decomposing carbonic acid into carbon and oxygen retaining the former for their own nourishment and giving out the latter for the purification of the atmosphere.

38. *The Rain*.—Air is also purified by the rain which during its descent washes down the diffused and suspended impurities to the earth.

39. Although nature's provisions may be sufficient for the change and purification of air without yet they are decidedly insufficient and inefficient for the renewal and purification of air within and about our dwellings seeing that it is rendered far more impure than the air without by peculiar causes or the same causes acting in a concentrated form. Hence the necessity for having recourse to some artificial means such as ventilation, deodorants and disinfectants, in order to renew and purify effectually the air within and about our dwellings.

40. Ventilation is the supply of abundance of air of normal purity to places inhabited by men or other animals. The object to be obtained by ventilation is not understood by many. The diminution of oxygen, in the air which is being respired by a number of persons assembled together, is not the particular evil to be guarded against. But it is the addition to the air, of carbonic acid and animal matters in a vaporized state which constitutes its foulness. The oppression which is felt on entering crowded rooms and ill-ventilated houses is not

caused by any loss of oxygen to the system but by the inhalation of air which has been already breathed over and over again and which holds in suspension noxious animal emanations.

41. A single grown-up man, as stated before, produces in a single hour by means of respiration and cutaneous exhalation about 960 cubic inches of carbonic acid, $7\frac{1}{2}$ Rupees weight of watery vapour and some other foul animal matters besides. Many people in this country boast of their cleanliness by refusing to drink water from a vessel which another man has just touched with his lips. Should not such people be shocked to know that, every time they crowd together in ill-ventilated rooms, each man inhales, in every hour, air containing about 1,000 cubic inches of carbonic acid, $7\frac{1}{2}$ Rupees weight of watery vapour and some other foul animal matters emanating from the lungs and the skins of his neighbours.

42. The presence of carbonic acid in the respired air can easily be proved. If you get a wide necked bottle (any clear glass vessel will do) and fill it about one-third with clear lime water or chunam water and breathe into it for a minute or so, the clear lime water will at once turn thick and milky white. It is the property of carbonic acid to combine chemically with lime water and form with it carbonate of lime or chalk. The thick milky fluid resulting from the exposure of lime water to carbonic acid is nothing but fine chalk mixed with water.

43. As for the watery vapour from our lungs, sometimes we can see it very clearly. On a cold dewy morning we can see the clouds of steam coming out of our mouths. This

steam is only very fine particles of water. By proper means we can make this steam turn into large drops of water. In warm weather we do not see the steam but if we will breathe on a looking glass at any time, we will make it dim and damp directly with the water of our breath.

44. The foul animal matters emanating from our lungs and skin are nothing but little particles of our own bodies just ready to decay and putrefy. Though we cannot see these, another of our senses can find them out if we take notice. They soon give the air a close disagreeable smell. Good air has no smell at all.

45. The effects of breathing the air of crowded and ill-ventilated rooms, which contains an excess of aqueous vapor and of the foetid and poisonous animal matters emanating from the lungs and the skins of the inmates, are well marked. A few hours will suffice to produce oppression, head-ache, nausea, giddiness, loss of appetite, thirst &c. The peculiarly close and disagreeable odour from animal exhalations in crowded and ill-ventilated rooms will be strongly perceptible in the early mornings after the full number of inmates have slept in them for some hours. It is to be remembered that the foetid odour is more perceptible to us in proportion to the purity of the atmosphere from which we pass straight into the impure rooms and that the inmates of such rooms themselves are unconscious of the odour, from the fact that breathing foul air impairs and gradually destroys the perception of its foulness.

46. Every room which is used for sitting or sleeping should have at least two windows which

should be of sufficient size and placed in the opposite walls. If the air that enters through one window does not find its exit through an opposite one, there cannot be any free circulation of air through the room.

47. It will be advantageous to place suitable openings near the top of large and high rooms. As heated bodies become expanded or rarified and consequently lighter and have a tendency to rise above heavier bodies, so the air of a crowded room, holding its impurities, becomes heated, rarified and rendered lighter by the respiration of the inmates and perhaps also by the burning of lights and consequently rises up to the ceiling. If therefore no provision has been made for the escape of the upper stratum of air through openings placed in the upper parts of the walls, the ventilation of the room cannot but be imperfect. The upper openings will serve mainly for the egress of the impure and heated air from within while the doors and windows below will permit chiefly the ingress of the pure and cold air from without.

48. Ventilation of our bedrooms ought especially to be attended to. When we remember how large a portion of our existence is passed in the bed-room, how the wearied frame there courts the influence of "tired nature's sweet restorer" and seeks a renovation of power for the labours of the ensuing day, we must feel how important it is that the air there inhaled should be fresh and freed from impurities whose poisonous action may "murder the innocent sleep."

49. Many people from fear of taking cold or getting other diseases, carefully close all the windows of their bedrooms and seal up every aperture for fresh air. These people should remember that when three or four persons thus sleep in a room, the air of that room, however large it may be, will in a few hours be exhausted of its oxygen by the respiratory

action of three or four pairs of lungs while it becomes saturated with most deleterious animal exhalations. They should also be made aware that the diseases and disordered functions of the body, such as rheumatic and neuralgic affections, biliary derangements, colds, coughs, sore throat &c. which are vulgarly attributed to cold, all owe their origin to one of the two following causes. In the first place, the atmosphere of such bed-rooms is so loaded with moisture and animal exhalations already, from prolonged contact with the bodies of the inmates, as to be incapable of absorbing more than a small part of what should be removed from the body ; or else in the second place, when the body, already in a heated and relaxed condition from the action of the warm and impure air within, is suddenly exposed to cold and moist air from without, the skin is chilled and the excretions which are struggling to gain exit from it, are condensed and driven back upon the system causing all manner of derangements. Thus we can understand that free and equable circulation of fresh air through a bed-room can never produce any ill-results but that on the contrary it does confer health and strength on the inmates.

50. Except in very cold and damp weather all the windows especially of the sleeping room should always be kept open. Even in cold weather, air may safely be admitted in an indirect way by causing it to pass through other rooms or passages before entering the room where persons are sitting or sleeping. Or else the ingress of air may be secured by fixing, in the open windows, bamboo tatties or zinc plates with holes perforated in them through which the fresh cold air can enter in a divided and diffused form.

51. Ventilation as regards Children. When we consider the activity with which respiration and other vital functions

are performed in children and the evil consequences induced by submitting them to vitiated air, it is evident that attention to ventilation is, in their case, of the highest importance. The largest and most airy rooms in the house, especially in large towns, should be appropriated as their sleeping rooms.

52. Of course the cold air, that enters by imperfectly fitting doors and windows or in any other way and comes in the objectionable form of draughts and imparts a sensation of cold to the part of the body exposed to it and produces unpleasant results, should be avoided.

53. Ventilation refers to the exterior as well as the interior of houses which should be so arranged, with respect to one another and to the streets on which they border, that the air should at all times be enabled to circulate freely around them. If houses be too closely surrounded by other buildings without intervening open spaces left between them, there will be difficulty for the admission into and free circulation through those houses. If the air without be vitiated, it is obvious that our efforts at internal ventilation will be unattended with success.

Deodorants and Disinfectants.

54. Deodorants are substances which destroy offensive odours. There is no necessary connexion between stinks and injurious atmospheric impurity, some offensive gases and vapors (as sulphuretted hydrogen) being deleterious while others also poisonous (as carbonic acid and malaria) are not perceptible by the sense of smell. On the other hand, air impregnated with innocent odours may be exceedingly offensive to the nose. Deodorization, therefore, in itself is comparatively of little importance to health. It may even do mischief by leading to the belief that an impure atmosphere is pure because it is inoffensive to the sense of smell.

55. With a view to remove the offensive smell of poisonous emanations many people of this country

employ perfumes and other ineffectual means. Perfumes may cover the offensive smell of poisonous effluvia but they can never destroy their baneful quality. It is said of the ostrich, a huge bird found in the deserts of Africa, that when it sees any danger approaching, it immediately buries its head in the sand and thinks foolishly that the danger has passed away because not perceptible. Those who employ perfumes and other similar means to cover the offensive smell of foul gases and think that their ill effects have been thereby removed, act like this foolish bird or the ignorant man who would take a bitter poison after mixing it with sugar to cover its disagreeable taste. It would be more sensible and effectual to maintain cleanliness in and about houses and avoid all sources of foul gases and emanations.

56. Disinfectants are substances which destroy or prevent the generation of atmospheric impurities injurious to health.

57. There is danger of overrating the efficacy of disinfectants and of allowing their use to supersede ventilation. They must always be considered subsidiary to ventilation which is the great means of purifying a foul atmosphere and they can never be substituted for it.

58. Among disinfectants, charcoal is one of the best. It absorbs sulphuretted hydrogen and other gaseous products of the decomposition of organic matters. Foul gases are absorbed and oxidized or destroyed by means of the oxygen which is present in the pores of the charcoal. Of some poisonous

gases, charcoal absorbs into its pores and destroys as much as ninety times its own volume. It is a cheap and effective disinfectant and should invariably be present in sick rooms, latrines, sewers and other places where offensive and unwholesome gases exist. Its efficacy is proportional to the amount of surface exposed and therefore it should be broken up into very small pieces or made into coarse powder. Fresh charcoal, either in small pieces or in powder, may be put in small baskets or in bags of coarse cloth and hung up in places where foul gases are generated. The charcoal basket or bag should occasionally be emptied of its contents and replenished with fresh charcoal.

59. Dryearth, especially if it includes clay, is a powerful absorbent of offensive emanations. If dry and powdered earth or clay be thrown over and thoroughly mixed with excrementitious matters, it will absorb or prevent the generation of foul effluvia which would otherwise taint the atmosphere and charge it with the seeds of disease. The ashes of dry cow-dung used as fuel in this country may be employed as a deodorizer like dry earth.

60. Lime water or chunam water, which has a powerful affinity for carbonic acid, is used for purposes of disinfecting close places, sick rooms &c. Lime water applied to buildings in the form of white-wash deodorizes and neutralizes temporarily at least the effects of such organic matters as may be adherent to the walls. Walls should be periodically white-

washed. They should be carefully scraped before every fresh coat of lime-wash is applied and the scrapings should be burnt or buried.

61. Common salt is a useful disinfectant. Any impure room may be disinfected by the fumes evolved by throwing some salt over a brisk charcoal fire.

62. Iodine vapor is a powerful disinfectant decomposing sulphuretted hydrogen, destroying putrid emanations and arresting putrefaction. This agent may be employed to disinfect rooms occupied by patients suffering from small-pox and other infectious diseases. A drachm of iodine placed in a flat vessel and suspended from the ceiling will disappear by slow evaporation and disinfect the impure air of the room.

63. Nitrous acid has a powerful effect on organic matters. It destroys offensive organic vapors and is well adapted for deodorizing places where dead bodies are exposed. It is highly irritant to the lungs and air passages and induces nausea and vomiting in some persons. It is therefore not fit for use in occupied rooms. Nitrous acid fumes are readily evolved by the action of oil of vitriol on nitre or of nitric acid on copper.

64. Sulphurous acid decomposes sulphuretted hydrogen and some other foul gases and arrests putrefaction. It affords a convenient means of disinfecting rooms in which cases of contagious and infectious diseases have been treated, and with the aid of heat is probably the best disinfectant of polluted clothes. Its irritant and suffocative effect when inhaled forbids its use in occupied buildings. Rooms to be disinfected should be cleared of inmates before fumigation with this agent and freely ventilated afterwards. Sulphurous acid or sulphur fumes

may easily be produced by throwing sulphur in powder over burning charcoal.

65. The vapor of vinegar, diffused by sprinkling the liquid on a hot brick or hot plate of iron, is deodorant and capable of neutralizing or decomposing some few gaseous products.

66. Carbolic acid is a powerful and a valuable disinfectant. It completely arrests the putrefaction of organic matter and destroys the germs or seeds of many diseases. If one part of strong carbolic acid diluted with from 50 to 100 parts of warm water, be sprinkled about places where foul gases and emanations exist, it will remove their bad odours and counteract their baneful effects.

67. *Light*.—Before concluding this chapter on air, it may be of some advantage to consider briefly the influence of light upon the physical condition of human beings. The effect of light is seen on a large scale in the blanched appearance of many inhabitants of large towns, compared with the healthier and stronger look of rustics who gain their livelihood in the field or garden, exposed through the greater part of the day, to the sun-light.

68. Who has not been struck with the pale and sickly complexion, the feeble and flabby muscles, and in some cases the stunted growth and the deformed body of many Zennana women among those classes and castes of the people of this country who most carefully and religiously shut up their females in their houses, and cruelly deprive them of the full blessings of light and air? It is to this deprivation of light that we must attribute most of the diseases and derangements of the digestive and nervous systems, such as, dyspepsia and hysteria which so commonly prevail among the Zennana ladies. In not a few cases the offspring of such ladies will be found to be more or less deformed, stunted, feeble and miserable looking children.

69. We may form an idea of the ill effects of the deprivation of light upon our health by studying the effect of that vital agent upon the vegetable world. So intimate is the relation between the daily and hourly growth of vegetables and the amount and direction of light, that many of them turn their flowers to the sun throughout his whole course from east to west. If a growing plant be kept in the dark, it has a faded aspect, is pale and sickly in appearance and if the light be entirely excluded, becomes perfectly devoid of colour. Plants always evince a tendency towards the light which is essential to their well-being. The side of the plant next the light performs its vital functions far more vigorously than that removed from it, its foliage becomes more luxuriant and the woody fibres of the stem of that side becoming denser and firmer, draw the weaker and more elongated fibres of the other side with them and cause the plant to bend towards the light.

70. As plants turn pale and weak when kept in the dark, so people, who are confined in dark houses and who do not go out freely to enjoy light and air, turn pale and weak, and again as plants try all they can to get to the light, so people ought to try hard to enjoy the full benefit of light and air.

CHAPTER III.

WATER.

71. By the action of the sun's rays upon the surface of the ocean watery vapour is produced. This vapour rising up in the air forms clouds and when condensed by cold descends back to the earth in the form of rain and contributes to the formation of rivers, lakes,

springs &c. Thus the ocean becomes the source of all kinds of water.

72. Water varies in its qualities and effects according to the ingredients which it contains and these depend chiefly upon the source whence the water is derived.

73. *Distilled Water*.—The purest water is that which is obtained by the process of distillation which is now very largely used at sea and affords an easy way of getting good water from sea or brackish water. But the process of distillation which removes the impurities of the water deprives it at the same time of the carbonic acid and atmospheric air on which its sharpness depends and by which it is rendered agreeable to the taste. Distilled water or boiled water may however be aerated and thereby rendered palatable by allowing it to run through a cask or an earthen pot the bottom of which is pierced with fine holes so as to expose the water in small streams to the air.

74. *Rain Water*.—The nearest natural approach to distilled water is rain water. But rain water is likely to be contaminated in its fall by various impurities with which the atmosphere is generally impregnated. Besides the impurities which rain water may derive from the atmosphere through which it passes, it necessarily takes up others, and in large quantities, from the surface of the ground on which it falls. When it falls on a roof—a flat one more especially—dust, organic and inorganic

matters, excreta of birds, bones and feathers, dead insects &c. contribute to the impurity of the water. And when the rain water is received into a tank filled by surface drainage, all kinds of soils and surface impurities of the drainage area such as vegetable and animal debris of every kind will of course contaminate the water.

75. *River Water*.—Many populations are dependent upon rivers for their water-supply. Rivers are often rendered impure by the washings of their beds fouled with every kind of impurity during the dry season and on the nullahs which open into them; by living or dead animals thrown into them; by men washing their persons, clothes and cattle; by heavy rains and floods bringing in soils and vegetable and animal debris from higher regions and by the overflow of marsh waters. Again rivers are often rendered impure by sewage of towns and drainage from slaughter-houses, tanneries, dye-works &c. and by such trades as pour their refuse waters and substances into rivers.

76. *Spring and Well Water*.—Spring water is both pure and impure in different cases and the mere fact of its being a spring is not a test of goodness. Shallow well water is always to be viewed with suspicion for it is the natural point to which the drainage of a good deal of surrounding land tends.

77. A well drains an extent of ground around it in the shape of an inverted cone which is in proportion to its own depth and the looseness of the soil in very loose soil a well of 60.

or 80 feet will drain a large area, perhaps as much as 200 feet in diameter or even more but the exact amount is not precisely determined. It is stated that the deepest ordinary well will not drain a cone which is more than half a mile in radius.

78. The composition of well water depends upon the soil through which the well is sunk, the condition of the neighbouring surface and the measures taken to preserve the water from contamination. That portion of the rain which sinks into the ground percolates into wells dissolving the soluble matters with which it meets in its course. Cess-pools, sewers, and pools of stagnant waters will contaminate wells, with organic matters, if situated within the drainage area. Also excrementitious and other refuse substances thrown out on the surface of the ground will contribute organic impurities to the soil and thence to the well water.

79. Besides the impurities to which the water of wells is liable, derived through the soil in which they are sunk, they may receive foreign substances directly through their mouths. Surface floods may wash into them every kind of impurity organic and inorganic; animals may fall in; persons suffering from painful diseases or fits of passion, jealousy or grief not unfrequently choose throwing themselves into a well as a convenient mode of terminating life and the winds may blow in dust, leaves &c. Very often foul vessels used for drawing contaminate the water.

80. The purity and wholesomeness of well water depend, therefore, on the position and protection of the well. Wells should be preserved from all avoidable pollutions and those selected for use should be free from external sources of impurity. Thus the neighbourhood of burial grounds, cess-pools, sewers or ill-constructed surface drains, nullahs (which are very often used as latrines), tanneries and slaughter-houses, unclean dwellings, stagnant surface pools or tanks in which human beings or animals habitually bathe or clothes are washed and fields which are freely manured should be avoided in choosing a well for domestic use.

81. The surface around, within the drainage area, should be kept free from animal and vegetable refuse, and should be carefully drained so as to afford no lodgment to water. The mouth of the well should be surmounted with a parapet and surrounded by an impermeable platform, of good brick and chunam work, sloping from its base and provided with a drain so that spilled water may not return into the well. A well which was long disused should, if required for use, be emptied, cleaned, allowed to refill and the fresh water left long enough to deposit suspended matters.

82. The geological formation of a district or the nature of a soil has necessarily a great influence upon the composition and wholesomeness of the water running through it or springing from it.

83. *The Granitic Waters.*—The waters derived from granitic

soils are generally pure. They contain the least amount of organic matter and are wholesome.

84. *The loose Sand and Gravel Waters.*—In this case there is a great variety of composition. Sometimes the water is pure. In tolerably pure gravels not near towns, the water is often free from impurity. In the case of many sands, however, which are rich in salts, the water is impure. These waters often contain a good deal of organic matter.

85. *The Lime Stone Waters.*—These are clear sparkling waters of agreeable taste. Organic matter is usually in small amount. But they are not as wholesome as they are palatable. They are hard and consequently pulses and other vegetables cannot be boiled in them perfectly and they are said to produce sometimes stones in the kidneys or bladder.

86. *Clay Waters.*—Very few springs exist in the stiff clay; the water is chiefly surface; it varies greatly in composition and often contains much suspended matters and few dissolved constituents. It is more or less impure and unwholesome and requires to be carefully purified by boiling and filtration.

87. *Alluvial Waters.*—(Alluvium is usually a mixture of sand and clay.) These waters are generally impure with much organic matter in them. *Surface and sub-soil water* is often very impure, and always to be regarded with suspicion. Cultivated lands, with rich manured soils often charge the water with organic matter and salts in large quantities. *Marsh water* contains a large amount of vegetable organic matter and is impure. Water from *graveyards* contains sometimes fatty acids and much organic matter which are injurious to health. All these waters should be avoided as quite unfit for drinking and cooking purposes unless (when no better water could be procured) they are carefully purified by some effectual means, as boiling, filtration or addition of some purifying substances.

88. *Search for Water.*—A plain should be well surveyed and

if any part seems below the general level, a well should be sunk. The part most covered with herbage is likely to have water nearest the surface. On a dry sandy plain, morning mists or swarms of insects are said sometimes to mark water below. Near the sea, water is generally found; even close to the sea it may be fresh, if a large body of fresh water flowing from a higher ground holds back the salt water. But usually wells sunk near the sea are brackish, and it is necessary to sink several, passing farther and farther inland, till the point is reached where the fresh water has the predominance. Among hills the search for water is easier. The hills store up water, which runs off into plains at their feet. Wells should be sunk at the foot of hills, not on a spur, but, if possible, at the lowest point; and if there are any indications of a water-course, as near these as possible.

89. *Characters of Drinking Water.*—The general characters of good water are transparency or perfect clearness, freedom from any smell or taste, coolness, and a certain degree of softness, so that cooking operations, especially of pulses and other vegetables, can be properly performed. Any water, if decidedly turbid, is suspicious, even if the turbidity be separable by coarse filtration, or if there be any smell or taste. Any water so turbid as not to be purified by coarse filtration or having a decided smell or taste, is impure.

90. When a suspected water is slowly evaporated to dryness by heat and the residue carefully burnt, if there is any great blackening and a decided smell of burnt horn, the water must be considered decidedly impure.

91. *Diseases produced by the use of Impure Water.*—Organic impurities, especially those of animal origin

and arising from faecal contamination, are often productive of serious consequences. The intestinal canal is most liable to disturbance, and diarrhoea and dysentery are not unfrequently due to this cause. Animal organic matters capable of causing such irritation to the bowels, often find their way readily into drinking water of wells, tanks, and rivers situated in or near densely populated towns, when they receive into them impure waters which have washed or percolated through filth-soaked ground around them or which have been polluted by communication with cess-pools, gutters or other accumulations of filth.

92. It has often been observed that water, abounding in organic matters having been drunk for months or even years with impunity, has suddenly developed poisonous materials. In some cases this may be due to unsuspected communication with a foul drain or cess-pool, suddenly established or enlarged; in others unusual elevation of temperature may have concentrated the impurities by the evaporation of the water or set up putrefactive changes irritating to the bowels. Epidemics of dysentery or diarrhoea recurring annually in the hot season are probably attributable to one or other of these effects of heat upon drinking water.

93. Simple diarrhoea has always been known to be largely caused by animal organic matters either suspended or dissolved in the drinking water. It is now generally believed that typhoid fever, cholera, and dysentery are caused by water rendered impure by the evacuations passed in those diseases. It is especially the belief of many medical officers that cholera evacuations, finding their way into the drink-

ing water, cause the spread of the disease. That in India the cholera poison is often carried by water, appears probable, from the very sudden and violent outbreaks, and the great sewage contamination in the water of many districts.

94. In the year 1854 cholera raged furiously in a large town in England, and in the course of a single week, carried off several hundreds of the inhabitants; and when the water of a well which was used by the people of that town was examined by a medical officer, it was found to have been contaminated by sewer waters, which percolated into the well, from a drain that was running not far from it. A lady, who lived three miles from the infected town, was in the habit of getting her daily supply of water from the same well. This lady and two or three inmates of her house fell victims to the disease, and they were the only individuals who were attacked and killed by the epidemic in all that village.

95. Many outbreaks of cholera tend to prove either that the suspected waters contained the germ or poison of the disease derived from the evacuations of the patients, or that they predisposed the system to be more easily acted upon by the poison received from other sources. It may be that the use of water holding putrescent animal matter would favor the spread of cholera by exciting a non-specific or ordinary diarrhoea which can act as a predisposing cause increasing the susceptibility of the system to take in readily the specific cholera poison or cholera germ. Either directly or indirectly, therefore, water thus polluted favors the spread of the specific diseases.

The means available for the purification of water.

96. Distillation removes almost all impurities from water.

97. Boiling precipitates some impurities to the bottom; expels foul gases dissolved in the water; destroys the vitality of the germs and eggs of some minute plants and animals; and may also break up and render innocuous certain animal poisons capable of exciting specific diseases, such as typhoid fever and cholera. Where fear is entertained respecting the transmission of these two diseases, the water should be subjected to thorough boiling, and it may then be considered safe for use.

98. The impurities in water are either suspended or dissolved. A suspended impurity is one which, although mixed with water for a time, is more or less readily separated from it either by subsidence or filtration. Subsidence is spontaneous settling down to the bottom of the vessel. Filtration is another term for straining. A dissolved impurity is one that becomes combined with the water and cannot be separated from it either by subsidence or filtration. It is generally removed or destroyed by heat or any chemical agent. For example. Finely powdered sand and chalk when mixed with water will sooner or later subside or settle down to the bottom of the vessel or they can be separated from the water by filtration or straining. Whereas sugar or salt, when added to water, becomes at once dissolved in it, so that

it cannot be separated from it by subsidence or filtration; but it can be recovered by evaporating the water by means of heat.

99. Different impurities subside with different degrees of rapidity and completeness. Thus chalk and sand settle sooner than clay and are also more easily separated by filtration. Vegetable matter subsides slowly; and animal matter, especially that derived from sewage, being in a state of very fine division, and light, descends still more slowly. Both these are readily removed by filtration.

100. Sometimes subsidence or settling of impurities is greatly assisted by the addition of certain substances, as the seed of the *Strychnos Potatorum* or the clearing nut, and alum. For example, finely divided clay is sometimes not separable by spontaneous subsidence, or by filtration as through sand and charcoal. But a small quantity of powdered alum, six grains to the gallon, added to such water, will generally, after 12 hours' rest, cause subsidence. Again the bruised nut of the *Strychnos Potatorum* rubbed on the inside of the water vessel, in the proportion of about three grains to ten gallons, has the same effect in 24 hours. Astringent substances, such as catechu, areca nut or betel nut, and especially tea are also supposed to obviate in a great measure the ill effects of using turbid or muddy water. These substances seem to cause subsidence of certain impurities of the water.

101. Free exposure to air by agitation or by

division into narrow streams, promotes oxidation of organic impurities, removes offensive organic vapors and sulphuretted-hydrogen, and increases aeration. By oxidation (combination with oxygen) putrescent and other hurtful substances are converted into harmless products. Water freely exposed to air, especially if moving continually as in rivers, undergoes, spontaneously but slowly, this kind of purification. On a small scale, water in divided streams passing through fine holes at the bottom of one vessel into another vessel, loses by a similar process its organic impurities.

102. Filtration through charcoal acts similarly by bringing oxygen absorbed into its pores into intimate contact with the oxidizable impure organic matter. Certain water plants have a purifying effect, apparently from the large quantity of oxygen they give out.

103. The potassium permanganate or Condyl's fluid, supplies oxygen for the same purpose by its own decomposition. The best mode of purifying any foul water by Condyl's fluid is as follows. In the case of any foul smelling or suspected water, add good Condyl's fluid (which is of a beautiful pink color) teaspoonful by teaspoonful to 3 or 4 gallons of the water, stirring constantly. When the least permanent pink is gone, add 36 drops, or if necessary, 30 more, and then allow to stand for six hours; then add for each gallon 6 grains of a solution of alum, and a little of sodium carbonate, and allow to stand for twelve or eighteen hours. If not clear, filter through charcoal.

104. *Filtration.*—Filtration or straining is a common and a very good means of purifying water. Various porous materials are used for filtration, such

as, sand, gravel, pebbles, porous rocks (as sand stones), charcoal (either animal or vegetable), and flannel. Of these, clean sand and charcoal are most commonly employed for filtering water for domestic purposes.

105. The common country filter consists of two earthen pots placed one over the other on a bamboo or wooden stand. The upper vessel has one or more small holes at the bottom and is half filled with a layer of clean sand, and another of clean charcoal. The water to be purified, when gently put into this vessel, percolates through the layers of sand and charcoal, and drops into the lower vessel, whose mouth is covered with a flat chatty having small holes in it to prevent any thing falling into the vessel.

106. Saltishness may be partly removed from water by filtration through a considerable thickness of sand and charcoal, and in this way brackish water may be rendered fit for use.

107. With regard to every kind of filter, occasional examination is necessary in order to ascertain whether use is impairing the efficiency of the filter. The filtering substance requires to be cleaned from time to time, either by removal, or washing and exposure to air and sunlight or heat. If sand and charcoal are employed as filtering materials, they should from time to time either be replaced by fresh sand and charcoal or the former should be thoroughly washed and exposed to the sunlight and the latter put into fire and heated to redness.

108. *Means of purification of water suited to*

travellers.—A little flannel bag, into which charcoal may be sewn, might be placed at the opening of a vessel, so as to strain the water. If the water is decidedly bad, it should be boiled with tea or some other astringent substance, and the cold infusion drunk. Travellers should understand that there is danger in drinking turbid water, as they will often do when they are overcome with thirst. Not only may all sorts of suspended matters be swallowed, but even small animals. On some occasions soldiers on a marsh have suffered from swallowing small leeches, which brought on dangerous bleeding.

CHAPTER IV.

FOOD.

109. In the animal body there is constant wear and tear of tissues. In the continual action of muscles and nerves, and in the discharge of various vital functions of the body, a constant waste of solid and fluid materials takes place. For every bit of work the body does, some part of it is wasted. Every step we take and every word we speak, waste a little bit of our body. Not only working, talking, lifting, pulling, pushing; &c., which we can all see and notice, waste us and make us get smaller, but there are other works of the body such as breathing, heart-beating and similar organic functions which go on without our will or knowledge and without

stopping even when we are asleep, and these also waste us. Again every time we think or reason, each thought causes some wastage of brain matter. If a man were weighed very accurately as soon as he gets up from his bed in the morning and again before breakfast, after he has been walking, talking and thinking for a few hours, there would be a considerable difference. He would be lighter at the second weighing than at the first, by reason of the wastage caused by walking, talking and thinking. By various ways the worn-out tissues of the body are thrown out of the system; some are thrown out by our lungs in our breath; some by the kidneys in the urine; some by the skin in the perspiration, and others through other channels. Thus the waste and effete matters, thrown out of the body of a single man of average size and growth in 24 hours by means of different excretory organs, have been calculated to weigh between six and seven pounds. By this constant wastage and loss sustained by our bodies, we should certainly dwindle away in a very short time, if no adequate means have been provided to compensate for such a loss. If a grown up man were weighed on two successive mornings at the same time, he would probably weigh on one morning just as much as he did on the other morning. And if a child were weighed in the same manner, it would probably weigh a little more on the second morning than on the first. All this waste of our bodies must be made good by new materials constantly supplied.

to them by some means or other. The principal means provided by nature to accomplish this important object, are our food and drink. The oxygen of the air we breathe also contributes towards this object to some extent. Every grown up man must take into his body every day, just as much new materials by way of food as he wastes, and children, who are growing, must take in a little more. In what way lifeless matter contained in our food and drink, such as bread, rice, vegetables, fruits, water, &c. is impregnated with life, and becomes like our own body being turned into flesh, bones, hair, skin, &c. is entirely beyond our understanding. In this as in other operations of creative power we have but to wonder and adore.

110. Again animal heat is of great importance in maintaining life. In order that this heat may be constantly kept up, there should be a constant combustion, and a constant combustion requires a constant supply of fuel. The fuel required for the maintenance of animal heat, is supplied by the fatty, oily, saccharine, and starchy elements of our food and drink. Thus we see the necessity of food for subsistence and continuance of animal life.

111. *Origination of Food.*—The food, with which animals must be constantly and duly supplied for their subsistence, consists of organic matter. All organic matter has its primary source in the vegetable kingdom; hence it follows that all our food must directly or indirectly be derived from that kingdom. The vegetable feeder goes directly for its food to the vegetable kingdom. The animal feeder is equally dependant upon the products of

the vegetable kingdom for its pabulum. But it obtains it only at second hand, so to speak, or in an indirect manner, its food consisting of the flesh of animals which have themselves been nourished upon vegetable products.

112. Now, it is only under exposure to the action of the sun's rays, that plants will grow, and hence it is to the influence of these rays, that we must refer the production of food in the first instance, and the primary source of all life upon our earth. Such seems to be the wonderful and yet simple provision which the Creator has made for the existence and continuance of animal life in our planet.

113. Light is therefore an important factor in the construction of organic compounds or substances by the plant. The elements of which these organic compounds consist are drawn from the inorganic or mineral kingdom, and chiefly from carbonic acid, water, and ammonia—substances which all exist to a greater or less extent in the atmosphere, and which are, to a large extent, if not entirely, derived from the atmosphere. In the case of the low vegetable organisms, which become developed in moist situations as a green layer on the barren surface of rocks and stones, the elements required for their growth must have been derived solely from the atmosphere. In the case of the higher organisms, however, the elements of growth are drawn from the soil as well as the atmosphere.

114. The stages, passed through in the history of vegetable life, leading to the provision of a fitting supply of food for animal existence, are very interesting and may be thus represented. Beginning, let us say, with a barren surface of rock (which may have been freshly exposed to the atmosphere from some subterranean, volcanic, or other agency,) the germs of low vegetable organism, which are supposed to be floating in the atmosphere, settle upon it, and extract from the atmosphere their elements of growth. Passing through their term of life, they die, and fresh ones spring up which simi-

larly live and die. So the process goes on, higher and higher forms of vegetable life making their appearance. The decaying remains of this primitive growth encrust what was a barren surface with a layer of earth or mould, in which ultimately the highest plants find a suitable position for taking root and growing. Thus clothed with vegetation, a fit locality is provided for the support of animal life; animal beings finding in the vegetable products now existing, the necessary material or food for their subsistence. This is exactly the process by which some of the mountainous islands produced by volcanic eruptions and especially the Coral Islands built up by those wonderful architects—the tiny coral insects—become gradually clothed with vegetation and thereby rendered fit abodes for animals including man.

115. Food to fulfil the requirements of animal life must contain mineral or inorganic as well as organic principles—a supply of the former being quite as indispensable as a supply of the latter. The productions of nature wisely contain, in combination, all that is wanted. In vegetable products we find not only the organic, but likewise the inorganic matter we require, and, in taking up and applying mineral matter as it does to its own purposes of growth as well as forming organic compounds, the vegetable organism contributes in a complete manner towards the supply of what is wanted for animal nutrition. A reciprocal relation, in reality, exists between what is supplied and what is wanted. We are as much adapted to the appropriation of the food supplied to us, as our food is adapted to our wants. Were we not so adapted, existence would be impossible for us. All things in nature are mutually adapted to each other, and, as such, they afford strong proofs of the wisdom and power of nature's Author.

116. In what has been said about the production of food by the vegetable kingdom for animal subsistence, it is seen that animals and plants stand in direct antagonism to each other,

as regards the results of the main operations of life. Plants draw their food from the inorganic or mineral kingdom, and produce organic compounds. Animals find their food in these organic compounds, and in applying them to the purposes of life, reconvert them into inorganic or mineral principles. In the appropriation of inorganic matter as food, plants absorb carbonic acid and set free oxygen. Animals, in their consumption of organic matter, absorb oxygen and give out carbonic acid. Thus animal life and vegetable life stand in complementary relation to each other, and it is in accordance with the requirements for the persistence of living nature upon the surface of our planet, that it should be so. If the operations of animal and vegetable life proceeded in one and the same direction only, the effect would be a gradual alteration of the chemical arrangement of matter, until a state of things was arrived at, unfit for the further continuance of life. Under the existing order of things, animals and plants in such a manner neutralise each other's effects upon surrounding matter, that they balance each other's operations, and thereby maintain a state of uniformity.

117. There seems to be an indissoluble band existing between all the sources of food. The vegetable draws water and minerals from the soil, while it absorbs carbonic acid, ammonia, &c. from the atmosphere and uses them in its own growth, and is then eaten to sustain the life of animals, so that animals gain the substances which the vegetable first acquired. But in completing the circle, the vegetable receives from the animal, carbonic acid, ammonia and various other refuses which are thrown off its body, and lives and grows upon them, and at length the animal itself, in whole or in part, becomes the food of the vegetable. Even the very skins, bones, &c. of animals are, by the aid of nature or of man, made to increase the growth of vegetables, and really to enter into their structure; and being again eaten, animals may be said to eat their own bones and live on their own flesh. Hence there is

not only an unbroken circle in the production of food from different sources, but even the same food may be shown to be produced from itself. Surely this is an illustration of the fable of the young Phoenix arising from the ashes of its parent.

118. *Classification of Food.*—The primary natural division of food is into organic and inorganic portions. The organic portion of food consists of substances produced only through the agency of life and therefore derived from the animal and vegetable kingdoms; while the inorganic portion of food is composed of materials simply drawn from the mineral kingdom and incorporated with the others.

119. The inorganic portion of food consists of water and various salts. The organic portion may be subdivided into compounds of which nitrogen forms a constituent, and compounds from which it is absent; in other words, into nitrogenised and non-nitrogenised compounds. The non-nitrogenised principles of food are composed of the three elements, carbon, oxygen, and hydrogen, variously united together, whilst the nitrogenised likewise contain these three elements, but, in addition, nitrogen as well.

120. First, therefore, food falls naturally into

Organic, and

Inorganic, divisions;

next, the organic is subdivisible into

Nitrogenous, and

Non-nitrogenous;

and further, the non-nitrogenous is again subdivisible into

Fats and Carbo-hydrates,

the former consisting of carbon and hydrogen in combination with only a small amount of oxygen, and the latter, of carbon with oxygen and hydrogen, always in such relation to each other as to be in the exact proportion to form water, that is, in the proportion of two atoms of hydrogen to one of oxygen. To this latter group belong such principles as starch, sugar, gum, &c.

121. Having said this much upon the classification of the principles of food, we shall next speak of them in relation to their respective qualities and effects upon the body, taking the groups in the following order.

122. 1, Nitrogenous principles; 2, Hydro-carbons or Fats; 3, Carbo-hydrates or starches, sugars, gums &c.; 4, Inorganic or Mineral materials, that is salts and water.

123. *Nitrogenous principles of Food.*—The nitrogenous principles of food are those whose primary function is the formation and repair of muscular, nervous and other important nitrogenous tissues of the body.

124. The nitrogenous principles are indispensably necessary for the maintenance and repair of the nitrogenous tissues of the body without which the development of energy is impossible, and in proportion to the activity and vigour of which, force is generated in the body. Wherever vital operations are going on, there nitrogenous matter is present, forming, so to speak, the spring or instrument of vital action.

The chief duty of animal life is the development of force by the oxidation or burning of carbon, hydrogen, &c., contained in the blood or derived from the food, but to this process of oxidation, the presence and action of nitrogenous tissues are essential. The nitrogenous tissues require nitrogenous principles of food.

125. The chief nitrogenous foods are, milk, cheese, flesh of animals, eggs, pulses, and cereal grains such as wheat, raggee and rice.

126. When the supply of nitrogenous foods is deficient, the functions of circulation, respiration, digestion &c. cease to be efficiently performed and a gradual failure of muscular strength and mental power, and a general condition of debility of the whole system will be the necessary results.

127. The effects of excess of nitrogenous foods depend on the digestive powers and the habits of the individual. Generally a plethoric condition, with congestion and enlargement of the liver, is apt to follow the continual use of excessive nitrogenous food, unless the amount of exercise is also increased, so as to cause increased absorption of oxygen and thereby effect the burning up and elimination from the system, of the surplus quantity of the nitrogenous food introduced into the body. Excess of force evinced by the irritability of temper and even savageness of disposition, seen in some individuals as well as nations, has been attributed to the use of excessive quantities of nitrogenous food.

128. *Non-nitrogenous principles of Food.*—While nitrogenous matter may be regarded as forming the essential basis of structure possessing active or living properties, the non-nitrogenous principles consisting of the second and third classes of food—the fats and carbo-hydrates—may be looked upon as supplying the source of power. The one may be spoken of

as holding the position of the instrument of action, while the other supplies the motive power.

129. *Fats*.—The chief varieties of fat in the animal are, butter or ghee, and the ordinary fat deposited in various parts of the animal body. Gingily oil, cocoanut oil, and other oils of vegetable origin, are also used in the preparation of food and they more or less serve the same purposes as animal fats.

130. When fat is taken in excess of the wants of the body, up to certain limits it is absorbed; beyond them, it passes off by the bowels. Animal fats are more readily absorbed than vegetable ones. That portion which is absorbed may be stored up in the body, leading to corpulence and fatty degeneration of some tissues and organs of the body, such as the heart, muscles, &c. Deficiency of fat in food leads to various derangements, and its complete exclusion has been found to cause depravation of health. Fat is an indispensable element of human food.

131. The functions of fat are manifold. It preserves the animal heat by its property of being a bad conductor of heat. By its oxidation (or burning with oxygen) it becomes a chief source of heat and other forms of force.

132. As a bad conductor of heat, the layer of fatty tissue, which lies beneath the skin, contributes towards retaining the animal warmth. This function it most conspicuously fulfils in the aquatic warm-blooded animals, such as the seal, whale, &c., in which

a coat of hair would prove of no service from the nature of the external circumstances that exist.

133. Accumulated in different parts of the animal frame, fat forms an internal store of heat or force-producing material to be drawn upon, when its supply from without is either deficient or entirely cut off for some time. Hence it is that life is sustained longer in a fat animal under abstinence from food and with a supply of water, than in a thin one.

134. In the hibernating animal, a greater accumulation of fat takes place during the autumn, which is favoured by the oily nature of the nuts, seeds, &c., then obtainable as food. At the end of the winter sleep, the animal is reduced to a comparatively emaciated condition. The fat accumulated may be looked upon as designed to form an internal store for consumption when the supply from without is suspended.

135. We shall next consider the functions fulfilled by fat by its oxidation within the body, that is, we shall now enquire into the final destination of fat in the animal economy.

136. The actual heat, expressed in units developed by one gramme or about $15\frac{1}{2}$ grains of the following substances, when burnt in oxygen, is given below. The unit represents the heat required to raise one gramme or about $15\frac{1}{2}$ grains of water, by 1.8° (or a little more than one and three-fourths degrees) according to Fahrenheit's thermometer.

	<i>Heat units.</i>			
Animal fat	9069
Starch (arrow-root)	3912
Cane sugar	3348

137. This is equivalent to saying that 1 lb of fat, by oxidation, will generate heat sufficient to raise the temperature of 9069 lbs. (about 4 tons weight) of water by 1.8° Fabr; that the oxidation of the same quantity of arrow-root will similarly raise the temperature of only 3912 lbs of water, and of cane sugar, only 3348 lbs. of water.

138. Looking at this difference in the relative value of fatty, starchy, and saccharine matters as heat-producers, we see the wisdom of the instinctive consumption of food, abounding in fatty matter, by the inhabitants of the arctic regions. The Esquimaux and other dwellers in the frigid zone devour with avidity the fat of whales, seals, &c., and find in this the most efficient kind of combustible material. In the tropics, on the other hand, the food, consumed by the native inhabitants, consists mainly of farinaceous and succulent vegetable matter. On account of the elevated temperature of the surrounding air, less heat is required to be produced within the body, and a less efficient combustible material is able to supply what is needed for the maintenance of the ordinary temperature.

139. It should be mentioned here that chemical combination of two or more elementary substances is always attended by the development of some form of energy or force, such as heat, light, electricity, magnetism, and mechanical power. The ordinary fires and the flame of the common lamp or candle, are nothing more than the continual development of heat and light, while the carbon and hydrogen of the wood, oil, or wax, chemically combine with the oxygen of the air. The result of the combination of oxygen with carbon is carbonic acid and with hydrogen is watery vapour. Whenever these combinations occur, heat and light are developed at the same time. Again the heat, light and the mechanical force suddenly developed on the explosion of gunpowder are the accompaniments of the various chemical combinations, such as the combination of carbon and hydrogen of the gunpowder, with the oxygen of the air, and the combination between the elements of the gunpowder itself as that of sulphur with hydrogen. If chemical combination be prevented by such means as complete exclusion of the oxygen of the air from the wood, oil, wax, or gunpowder, there cannot be any

development of heat, light, or mechanical force, and therefore there cannot be any burning of the wood, lamp, or candle, or any explosion of the gunpowder.

140. The production of heat in the body, so wonderful in the process and amount, results only from the chemical change or combination of the elements of food, and is thence called the combustion of food. As familiar illustrations of the production of heat from chemical combination we may mention the heating of hay stocks or large heaps of corn-sheaves, and the fact that when cold oil of vitriol and cold water are added together, the mixture becomes so hot that the hand cannot bear it. This action in the body is not restricted to changes in one element alone, but proceeds with all, yet it is chiefly due to a combination of three gases, viz, oxygen, hydrogen, and carbon, and requires for its support, fat, starch, sugar, or any digestible food composed of these substances, precisely as coal and wood supply fuel for fire without the body.

141. Thus we can prove that an ounce of fresh lean meat, if entirely burnt in the body, would produce heat sufficient to raise about 70lbs of water one degree. Fahr or a gallon of water about seven degrees Fahr. In like manner one ounce of fresh butter would produce ten times that amount of heat; but it must be added, that as the combustion which is effected within the body is not always complete, the actual effect is less than that now indicated.

142. We must now go to the discussion of the question of the application of fat to the production of muscular and nervous force, and what we have to say upon this point will apply not to fat merely, but to other forms of non-nitrogenous alimentary matter, such as starch, sugar, and gum.

143. The doctrine of the present day refers the source of muscular power or work to the oxidation of carbon and hydrogen of the non-introgenous matter, and it is founded upon the fact that carbonic acid and watery vapour are evolved in a

direct ratio to the amount of muscular work. Animals exhale far more carbonic acid when they are lively and active than during a state of repose.

144. The amounts of carbonic acid, exhaled by Dr. Smith under varying conditions of exertion, stood as follows :

Carbonic Acid exhaled per minute in grains.	
During sleep.....	4.99
Lying down and almost asleep	5.91
Walking at the rate of 2 miles per hour.....	18.10
Walking at the rate of 3 miles per hour	25.83
Working at the treadmill, ascending } at the rate of 28—65 feet per minute. }	... 44.97

145. The relation which has been shown to exist between the elimination of carbonic acid and the performance of work entitles us to consider that to the oxidation of carbon and hydrogen of the fatty, starchy, and saccharine matters, may be referred the production of power.

146. Just as matter is indestructible and cannot be created, so, it is now understood, is force. Force may be transmuted from one form into another ; from chemical energy into heat, mechanical power, and so on, but this, it is considered, is all that occurs, and what holds good for the world around us, is considered also to apply within the living organism.

147. Physiologists refer the chief source of heat to the oxidation of carbon and hydrogen, and to the same source is now ascribed the production of mechanical power. The energy set free by chemical action or combination, manifests itself under the form of mechanical work. The following simile has been suggested by Fick and Wislicenus.

148. " A bundle of muscle fibres is a kind of machine, consisting of nitrogenous material, just as a steam-engine is made of steel, iron, brass, &c. Now, as in the steam-engine coal is burnt in order to produce force, so in the muscular machine

fats, starches, or sugars are burnt for the same purpose. And, in the same manner as the constructive material of the steam-engine (iron, &c.) is worn away and oxidised, the constructive material of the muscle is worn away, and this wearing away is the source of the nitrogenous constituents of the urine. This theory explains why, during muscular exertion, the excretion of the nitrogenous constituents of the urine is, little or not at all, increased, while that of carbonic acid is enormously augmented; for, in a steam-engine moderately fired, and ready for use, the oxidation of iron, &c., would go on tolerably equally, and would not be much increased by the more rapid firing necessary for working, but much more coal would be burnt when it was at work than when it was standing idle."

149. Looking, then, at the evidence adduced, the result of modern research goes to show that the non-nitrogenous alimentary principles are applied not only to the production of heat, but likewise of other forms of force. It may be considered that nitrogenous matter, which constitutes the basis of the various organs and textures, forms the instrument of action, whilst the oxidation of non-nitrogenous matter supplies the motive power. The organs and textures containing nitrogenous matter may be compared to a gun, and the carbon and hydrogen of the fats, starches, sugars &c. to the gun-powder.

150. As in the case with reference to heat, the amount of mechanical energy producible is in proportion to the amount of chemical action occurring. A given amount of an organic compound, for example, will, as is well known, give rise, by oxidation, to the generation of a definite and ascertainable amount of heat. In the same manner, when the energy set free is manifested under the form of mechanical power instead of heat, a fixed amount of work is capable of being performed. The energy produced may present itself under the form of a certain amount of heat, or on the other hand, may lead to the accomplishment of a certain amount of work; not only

so, but heat and mechanical power are known to be mutually convertible, and a definite expression can be given of their relative value in representative equivalents.

151. According to the English system, work is measured by pounds or tons lifted a foot, and the measurement is expressed as foot-pounds or foot-tons.

152. Mr. Joule, of Manchester, has ascertained, and his conclusions are very generally acquiesced in, that the amount of energy, which under the form of heat will raise the temperature of a pound of water one degree Fahr., will, if manifested as mechanical force, raise 772 lbs a foot high, or, what of course amounts to the same, 1 lb 772 feet high. Thus the dynamic equivalent of one degree Fahr. of heat, is said to be 772 foot-pounds.

153. Applying this to the utilisation of food, the value of the various principles as mechanical power-producers will correspond with their value as heat-producers. As heat production is related to the amount of chemical action ensuing, so likewise is mechanical power-production. Such alimentary principle as will by oxidation give rise to the greatest amount of heat, will have the greatest capacity for the production of working power.

154. Amounts of mechanical work obtainable from the oxidation of one gramme ($15\frac{1}{2}$ grains) of the following substances are given below.

					In foot-pounds (pounds lifted a foot.)
Fat	...	...	...	...	27,778
Starch (arrow-root)	...	...	...	...	11,983
Cane sugar	...	...	...	...	10,254

155. Such is the modern way of regarding food in reference to its application.

156. It should be understood here that due oxidation of carbon and hydrogen of the non-nitrogenous principles of food and consequently the due development of heat, mechanical

or muscular power &c., depend not only upon the presence, but due development of the organs and textures containing nitrogenous matter, such as muscles, in the same way as the gun-powder depends for its effect, upon the nature and strength of the gun.

157. *The Carbo-hydrates.*—The carbo-hydrates include different kinds of starches, sugars, gums, &c. Although this class of food is not indispensable to life or health, it nevertheless enters into the diet of almost every kind of people. Starches are more important than sugars. But the former are less digestible than the latter. Their functions are the same as those of fats. By oxidation of their carbon, they yield force and heat, but they are much inferior in this respect to fats. They are convertible in the body into fat, largely in herbivorous animals; to a considerable extent in man. In this respect sugar is superior to starch. Starch is converted in the body into sugar before it is absorbed into the system. When too much starch or sugar is digested and absorbed, it is converted into fat, thus producing obesity and very often fatty degeneration of the heart and other structures of the body.

158. Imperfect digestion of excess of starchy food, generates acidity and flatulence of the intestinal canal. When too great a quantity of saccharine articles of food is used, it is very apt to derange the stomach and induce a disposition to maladies of a serious nature. Saccharine urine is often a result of excessive use of starchy food, and diabetes melitus is a

frequent disease among people who live mainly on starchy and saccharine foods.

159. The substances which supply starch almost exclusively are arrow-root, sago, tapioca, &c. The potatoe, and the cereal grains such as rice, also contain a very large proportion of starchy matter. Sugars are of various kinds, viz., cane sugar, palmyra or cocoanut sugar or jaggery, fruit sugar, milk sugar, honey, &c.

160. *Minerals*.—Minerals, consisting of various salts and water, constitute the fourth group of alimentary principles, and their presence is equally indispensable with that of the first or second class. They are essential to the growth and maintenance of solid tissues and of fluids of the body. Deficiency of salts exercises a very unfavorable influence upon health. An insufficient supply of common salt favours the propagation of intestinal worms. The amount of salt which is required in 24 hours, varies with the nature of the other articles of the dietary. Thus, 100 grains are perhaps sufficient for a man whose staple food is wheaten flour, while at least twice this quantity will be required for a man whose diet is principally rice.

161. *Water*.—A sufficient supply of water is even more necessary to life than food of any other class, and death by starvation takes place much more rapidly when water also is excluded than when the other kinds of food only are withheld. All the tissues of the body require water for their composi-

tion, and their vital processes are impossible without it. The quantity of water which the system demands, varies with the amount of work, the external temperature, the nature of the other elements of the diet, and the individual peculiarities and habits. The necessary amount of water may be stated to be, on the average, half an ounce for each pound of the body's weight, or 70 or 80 ounces for an adult man. If more is taken than is actually required, the excess rapidly passes off by the kidneys and the skin. Deficiency of water leads to a remarkable failure of the physical and mental powers. When great exertion has to be undergone, an ample supply of water should be provided. A considerable proportion of the necessary amount of water, is supplied in the so-called solid food, especially by the vegetable part of it, leaving a variable quantity to be taken as actual drink—a quantity which ranges from 50 to 100 ounces. The imperious demands of thirst will ensure that deficiency of water in the solid food will be compensated by liquid drinks.

162. The above classification of food into four groups will appear just and natural, if we study the composition of milk which is the simplest and the most perfect type of food, designed and prepared by nature for the mammalian animals in their infancy and on which they can live exclusively for a considerable length of time and thrive well. Milk contains in itself all the four fundamental principles of food described above, viz., (1) nitro-

genous principles, (2) fats, (3) carbo-hydrates, and (4) minerals—salts and water. The nitrogenous food is represented in milk by the casein which is the solid portion of the curds obtained from milk; the fats are represented by the cream or butter of milk, the carbo-hydrates, by the milk-sugar which is the cause of the sweetness of milk, and the minerals, by the different kinds of salts and by the large quantity of water contained in milk. Milk not only contains simply all the four fundamental principles of food which are necessary for the perfect growth and development of the animal body, but it contains them in such a manner that their relative proportions are best suited to the nutrition of animals for many months after birth.

163. We have, thus far, considered the fundamental principles of food or its classification into four groups. And now the ordinary articles of human food are to be considered separately, and we shall begin with those vegetable and animal substances which contain the nitrogenous or flesh-forming principles in greater or less proportion.

164. The vegetable foods containing considerable quantities of flesh-forming materials, may be divided into two groups viz. the pulses, and the cereal grains.

165. *The Pulses.*—The pulses or the seeds of leguminous plants, contain a very large proportion of nitrogenous or flesh-forming principle in the form of legumin or vegetable casein which closely resembles

the casein of milk. The chief varieties of pulses are dhol, Bengal gram, green and black grams, horse gram or khooltee, beans, peas, &c. These contain from twenty-five to thirty per cent of flesh-forming materials. One pound of pulses contains as much flesh-forming substance as fifteen pounds of potatoes. Looking therefore at their composition, one would be disposed to regard the pulses as more nutritious than wheat or flesh of animals. But owing to their comparative indigestibility by man, they are inferior as food to wheat or flesh, and are incapable of being digested in sufficient quantity to support human life by themselves. They are apt, besides lying heavy on the stomach, to occasion flatulence and colic. Added in small amount to starchy or fatty foods, they are of great value. They keep well, although becoming harder by time and requiring more careful cooking. They require slow and protracted boiling and, if old, should be steeped in water for twenty-four hours and crushed before attempting to cook them for food. The pulses are difficult to be boiled in some kinds of water, especially that which is obtained from chunam or limestone soils. To remove this difficulty to some extent, a small quantity of carbonate of soda may be added to the water in which the pulses are to be boiled. Generally they boil easily in rain or river water.

166. *The Cereals.*—The next group of vegetable foods which contain large quantities of nitrogenous or flesh-forming substance, are the cereal grains

which indeed form almost the universal staple food of the human races all over the world. The chief variety of the cereals used in India are wheat, rice, and the millets or dry grains, such as raggee, cumboo, or bajra, cholum or jaware and varagoo.

167. *Wheat*.—Wheat is the most important of all the cereal grains and is most extensively used as human food. It contains a very large proportion of nitrogenous or flesh-forming principle which constitutes about 10 per cent of its weight. It is also rich in digestible carbo-hydrates and in valuable mineral salts. On the other hand, it is deficient in fat and therefore requires the addition of butter or ghee if used in the form of bread or cakes. The nutritive value of bread is high. It is capable of being used as the staple article of diet for an indefinite period without producing distaste. Individuals are known to do very well on bread and water alone for months together. There is an account of a carpenter in England whose diet for many years consisted of two pounds of bread daily with water, and nothing else. He was in the habit of putting the bread into a large jug, which he filled with water, over night. This sop supplied him with three meals on the succeeding day. His health was excellent. •

168. *Rice*.—Rice is said to contribute to the support of a greater number of human beings than any other single vegetable, not excepting even wheat. It is of Asiatic origin, and has, from time immemorial, consti-

tuted the principal food of the populations of China, India, and the islands in their vicinity.

169. Rice is deficient in nitrogenous or flesh-forming substance which ranges from three to seven per cent of the grain. Raw rice or table-rice is more nutritious than the ordinary rice which is first boiled and then dried. In nutritive value, rice is the lowest of all the cereal grains. Hence it demands the addition of some highly nitrogenous food, as flesh of animals, milk, curds, or dhol or any other pulse. It is insipid and needs the aid of plenty of salt and condiments—much more than wheat or any of the dry grains. Rice appears to undergo some change by keeping, which renders it more easy of digestion. New rice almost invariably causes diarrhoea and other derangements of the bowels. It should therefore have been kept at least six months before it is used as food.

170. *The dry grains or millets.*—These form the staple food of large numbers of the inhabitants of this country and especially of the poorer and labouring classes of Southern India. They are called dry grains from the mode of their cultivation, which does not require such artificial irrigation as rice or wheat depends upon for its growth. The chief millets are cumboo, cholum, raggee and varagoo. As a class, they form a more nutritious diet than rice, and they contain on an average nine per cent of nitrogenous or flesh-forming principle.

171. Rice is used by the opulent and by the

inhabitants of towns, but one or more of the millets form the great staple food of the poorer, the labouring, and the industrial classes in many districts of the Madras Presidency. The Indian labourer is obliged to resort to the more nutritive of the cereals in preference to rice. The harder he works the better he lives. The good living is a necessity of the hard work. One could not be kept up without the other. Instead of feeding upon rice like the higher classes who take no active exercise, he depends upon the more nutritious raggee, cholam, or cumboo, for the staple of his food. Thus the revelations of science with regard to the unsuitability of rice, as a supporter of the strength for those who have to live by the sweat of their brow, are strikingly confirmed by the practical experience of the labouring classes in Southern India.

172. The rice-eating people are not so fine a race physically as those men who eat wheat or any of the dry grains. Dr. Fletcher of Cuddapah remarks of cholam—the staple food grain of the district, “It is a very wholesome and nutritious grain, and is much eaten by those who require to work hard and endure much fatigue, in preference to rice.” Dr. Wilson of Madura remarks of cumboo, another of the millets, “There are people living in the south-eastern portion of the district, called Reddies, who use this grain almost exclusively for food, and they are remarkable as being a tall, robust and muscular race. They are an agricultural people; some I

have measured and found to be six feet in height, and stout in proportion. They are not large eaters of animal food." The Dhees and the Mahrattas are hardy races. They are exposed to all the worst malarious influences in the district, and yet they are healthy to a wonderful degree. They use the dry grains more than rice.

173. There is one remarkable fact, and that is, the great preference given to rice, by those whose means will allow them to purchase it. Why this should be is strange, and not at all easy of explanation at a first glance. Raggee, cumboo, and cholum, not only contain nearly double the amount of nitrogenous ingredients, in a given weight, but they are much cheaper than rice, and occasionally twice or three times the weight of dry grains may be had for the price of a measure of rice. Poverty and the necessities of labour cause the poor to feed on the food best suited to their condition—wheat flour in the north of India and the millets in the south, but in the south at least, the labouring man sighs for the rice and ghee of the rich "Chetty or Brahmin" and estimates it as the perfection of diet, though beyond his reach.

174. The true explanation probably may be found in the fact, that rice has been the staple food of the Hindoos ever since they have had a history, and especially of the higher castes, who had no need to labour for their daily wants. To such a people, rice, aided by the milk and butter, the curds and sweetmeats and vegetables of their daily diet, was not an unsuitable food. The fact of its being so highly estimated by the higher classes was sure to make it desired, and sought after by the lower orders.

175. The general impression of medical officers is that the value of life is low amongst those who subsist chiefly upon rice. They become fat, bloated, and incapable of much exer-

tion. This tendency is no doubt increased by the amount of ghee and sweetmeats consumed. Decay of the vital powers usually sets in early. Men become grey-headed in early manhood, and dyspepsia in its innumerable forms is a common malady. Most troublesome boils and carbuncles, often associated with diabetes, are very frequent among the middle-aged men who chiefly live upon rice and sweetmeats.

176. Dr. Cornish says of the rice-eating populations as follows :—

“The fierce and warlike nations which have in past times devastated the rich plains of India, and tyrannised over the defenceless people inhabiting them, have all been consumers of a more nourishing food than rice. It may be safely argued that if the people had been fed upon the simple diet of the inhabitants of the plains, these conquests would never have occurred. The physical powers and moral courage necessary to the achievement of feats of valour and conquest, have never yet been found in a people who, like the degenerate races in the lowlands, live on a grain deficient in nitrogen and eschew animal food. It may safely be predicted that a people whose chief food is rice, is not destined to achieve distinction or fame in the history of nations. Incapable of severe labour, or of the courage and physical capacity for resisting the aggressions of outward foes, or of carrying war into an enemy's country, they will probably remain in the physical condition which Macaulay so truly describes in his picture of the Bengalee. The habits of caste and customs of forefathers may however be put aside in the progressive development of civilization ; and in that case, if the Hindoo of the rice districts can be brought to understand that a due proportion of animal diet is essential to his well-being, in eking out the supply of nitrogenous material in which his staple food is so deficient, the future history of the nation may be widely different from the past.”

177. Having hitherto considered the principal

articles of vegetable food which contain a greater or less proportion of nitrogenous or flesh-forming principles, we shall next direct our attention to those important alimentary substances which contain a large proportion of nitrogenous matter, but which are derived from the animal kingdom. Before going to the consideration of the different articles of animal food, it is proper here to discuss the subject of the propriety or otherwise of using animal substances as human food.

178. We may see that a great diversity exists as regards the food consumed by the human race in different parts of the globe. Instances are to be found where life is sustained upon a wholly vegetable, a wholly animal, and a mixed diet. The mixed diet, however, may be regarded as that which, in the plan of nature, is designed for man's subsistence. It is upon this that he appears to attain the highest state of health, physical development, and intellectual vigour.

179. Vegetarianism has, in this country, numerous devotees, who base their condemnation of animal food upon the assertion that it was never intended for man to slay his fellow animals for his own support, and that their flesh was not so suited to his digestive organs as vegetable food. The basis upon which they ground their assumption is an unsound one, being not only in opposition to the flesh-eating instincts of the whole human race in all ages, but also disproved by the fact that whole nations,

with similar digestive organs to our own, lie under the necessity of living almost entirely on animal substances.

180. In the arctic regions, where vegetation is scanty, men feed almost entirely upon animal fare. The fat and blubber of the seal, walrus, and other aquatic animals, supply the place of the starch and sugar of the vegetable world. In the tropics, where the fruits of the earth are brought forth in abundance, the human food is derived principally from the vegetable, and scantily from the animal kingdom. In the temperate regions, where the balance between animal and vegetable life is more equally maintained, both kingdoms contribute pretty equally to furnish a variety of food for man. Hence we see that man, above all other creatures, has the faculty of deriving his food and nutriment both from the animal and vegetable kingdoms.

181. Again, if we examine the digestive organs of mammalia, we can easily distinguish between those tribes which feed upon vegetable, and those which feed upon animal substances, the organs in question being far more complicated in the former than in the latter. In carnivorous animals, whose food is easy of digestion, the stomach is simple, and the intestinal tube comparatively short, not more than about four times the length of the body. The vegetable food of herbivorous animals would seem to require much more elaboration, and consequently, a more complex apparatus. In the ruminants, as the

cow and sheep, there are four distinct stomachs. The first is called the paunch, and food, too hastily deposited in this, is returned into the mouth for further mastication—chewing the cud. The paunch, and the second and third stomachs, appear to serve the purpose of softening and macerating the food prior to its introduction into the fourth stomach, where the more special act of digestion is performed. Again, in ruminants, the length of the intestinal tube varies from fifteen to twenty-five, or as in the sheep, to twenty-eight times the length of the body. In animals that take mixed diet, the formation of the stomach and the length of the intestinal canal are intermediate. In man the length of the intestinal tube is about six times the length of his body. His teeth also, though approaching to those of the carnivora, are mixed in character. Indeed, every thing in his organization tends to prove that he was intended for a mixed diet of animal and vegetable substances.

182. Moreover, it is a great mistake to suppose that there are any people in India, or in any other country of the world, who are absolute vegetarians. It is true that many castes or sects of Hindoos will not eat the flesh of animals, but such people use milk, curds, butter, &c. liberally in their diet, and these substances are purely of animal origin and do not belong to the vegetable kingdom.

183. In order to show that vegetable food is very well adapted for contributing to the performance of

muscular work, reference is sometimes made to our beasts of burden, which, as is well known, belong almost exclusively to the herbivorous tribe. When we look at the horse, who is purely herbivorous, and notice his strength, graceful proportions, and lightning movements, we cannot doubt that vegetable food is equally nutritious with animal food, so long as each is used in proper cases and in proper manner. Seeing, moreover, that the source of flesh in animals which are used as food is vegetables, it follows that vegetables should have the same elements as flesh, and it is a fact of great interest that in vegetables there are foods closely analogous to the flesh of animals.

184. From the foregoing considerations it is quite evident that so long as each class of animals uses the very kind of food which, in the plan of nature, is designed for its subsistence, it will and must certainly attain the highest state of health, physical development, and mental vigour it is capable of. Hence vegetable food is the most natural and the best adapted for the herbivora, the animal food for the carnivora, and the mixed food for the omnivorous animal—man. •

185. *Animal Food.*—Animal food being identical in composition with the structures of the body, requires neither addition nor subtraction to enable it to administer to the purposes of nutrition.

186. The chief characteristic of animal food is the large amount of nitrogenous matter it contains.

This adapts it for the construction and maintenance of the body.

187. *Flesh of Animals.*—Age, sex, size, season, mode of life, nature of feeding, and mode of death, exert a great influence upon the flesh of animals.

188. The flesh of young animals is more tender than that of old, but experience shows that it is more resistant to the digestive powers. The flesh of very young animals is found, by the dyspeptic, to tax the stomach more than that of middle aged animals. The flesh of an aged animal, as is well known, may be so tough as to render it almost refusable. Animals of middle age afford the most digestible and best flavoured meat.

189. Sex greatly influences the quality of the flesh, that of the female being more delicate and finely grained (the hen-fowl is very noticeably more tender and delicate eating than the male bird) than that of the entire male.

190. Violent exercise just previous to death gives increased tenderness to the flesh ; hence the greater tenderness which is well known to belong to the flesh of the hunted animal.

191. The flesh of domesticated animals in India is generally lean, and deficient in succulent juices. This arises from the fact that the feeding of cattle for human consumption is an art not at all understood or practised by the people of this country. They are wretched farmers as regards the care of their cattle. From the neglect to secure proper fodder during the

hot and dry period of the year, when all vegetation is at a stand-still, horned cattle get miserably thin, and often perish by thousands at this season from contagious epidemics. Cattle of this country are not very cleanly in their habits of feeding. Buffaloes, cows, and sheep often eat human excrement and other offal, when their own natural food is scarce. Excellent meat can be obtained by feeding animals with sufficient quantities of good grass.

Good meat is said to have the following characters :

192. It is neither of a pale pink colour, nor of a deep purple tint, for the former is a sign of disease, and the latter indicates that the animal has not been slaughtered, but has died with the blood in it, or has suffered from acute fever.

193. It should be firm and elastic to the touch, and should scarcely moisten the fingers; bad meat being wet, and sodden and flabby, with the fat which looks like jelly or wet parchment.

194. It should have little or no odour, and the odour should not be disagreeable; for diseased meat has a sickly, cadaverous smell, and sometimes a smell of physic. This is discoverable when the meat is chopped up and drenched with warm water.

195. To assist in judging of the freshness of meat, a clean knife may be passed into it and applied to the nose on withdrawal. In this way the condition of the centre may be ascertained.

196. *Eggs.*—Eggs necessarily contain all that is required for the construction of the body, as the young animal is developed from it.

197. Raw and lightly boiled eggs are easy of digestion. The hard boiled egg offers considerable

resistance to gastric digestion, and exerts a constipating action on the bowels.

198. The egg changes by keeping, and certain devices are practised to preserve its freshness. The shell, being porous, allows of the evaporation of fluid, and air accumulates in its place at one of the extremities. Thus an egg, under exposure to the air, loses weight from day to day, and the diminution in its density indicates the length of time it has been kept. For example, a solution of salt in the proportion of about 10 per cent.—that is, one ounce of salt in ten ounces of water, will just allow a fresh egg to sink, whilst one which has been kept several days will swim. Bad eggs become sufficiently light to float even in pure water.

199. The air, which finds its way through the pores of the shell into the egg, causes gradual decomposition, until ultimately a state of putrescence is attained. With the view of excluding the air, eggs are sometimes kept in lime water. The shell is sometimes covered with a layer of wax and oil, or some kind of fatty matter, or with gum. By packing eggs in bran, salt, or some such material, they keep longer than they otherwise would do; but it must be remembered that they easily acquire a taste from that which surrounds them. Immersed for some hours in a solution of salt, some of the saline matter penetrates, and tends to preserve the egg under subsequent exposure to the air.

200. *Milk*.—Milk, an article furnished and intended by nature as the sole food for the young of a certain class of animals, necessarily contains, like eggs, all the elements that are required for the growth and maintenance of the body. Holding the position it does, it may be justly regarded as the type of alimentary substance.

201. *The physical characters of good Milk,—* Placed in a narrow glass, the milk should be quite opaque, of full white colour, without deposit, and without peculiar smell or taste. When boiled, it should not change in appearance.

The effects of animal and vegetable food compared.

202. Although animal food certainly taxes the stomach more than the ordinary forms of vegetable food that we consume, as is well known by those who have weak digestive power, yet, taking digestion and assimilation as a whole, a more complex process has to be gone through where vegetable food has to be dealt with. Accordingly we notice that the digestive apparatus of the herbivora is developed upon a more extensive scale than in the carnivora. The difference, for instance, in the length of the intestinal canal is well marked.

203. Animal food, with its preponderance of nitrogenous matter, tends to produce firmness of muscle with an absence of superfluous fat. Vegetable food, on the other hand, tends to increase the deposition of fat. Animals, consuming food containing an excessive quantity of nitrogenous matter, show a greater disposition to increase in frame and flesh. If we direct our attention to the animals around us, it is open to common observation to notice that vegetable feeders show a greater proneness to become fat than animal feeders. The animals we fatten, all belong to the herbivora, and even dogs and cats become fatter on vegetable food—a proof that it is more the nature of the food than the kind of animal, that makes the difference. Mr. Banting found that limiting his supply of vegetable food enabled him to reduce his corpulence, and it is upon the application of this principle that the system of “Bantingism” rests.

204. Animal food appeases hunger more thoroughly than vegetable, and satisfies longer. In other words, it gives, as

general experience will confirm, greater stay to the stomach. It also exerts a greater stimulating effect upon the system generally. Accounts are related of the stimulant properties of animal food having sufficed, in certain instances, (as after starvation and in those accustomed only to a vegetable diet,) to produce a state resembling intoxication.

205. The general character of an animal is related to its food. Liebig says it is essentially their food which makes carnivorous animals, in general, bolder and more combative than the herbivora, which are their prey. "A bear kept at the Anatomical Museum of Giessen showed a quiet gentle nature as long as he was fed exclusively on bread; but a few days feeding on meat made him vicious and even quite dangerous. That swine grow irascible by having flesh food given them is well known,—so much so, indeed, that they will then attack men." It might be considered as a part of the plan of nature that this relation should exist. It need not be that the animal food gives origin to the ferocity, but that the ferocity exists to enable the animal to obtain its food.

Proper Amount of Food.

206. The amount of food required depends upon the existing circumstances. No fixed quantity can be given as suited to all cases. Variations in external temperature, the amount of work performed, and individual peculiarities, occasion a variation in the amount of material consumed in the body; and in a properly arranged diet, the food should be adjusted accordingly. For this adjustment Nature has provided us with a guide in the instinct of appetite with which we are endowed. Appetite, or, in its more exalted character, hunger, apprises us that food is required, and produces an irresistible desire to seek and obtain its supply. By attending to its dictates a knowledge is also afforded of the proper amount to be consumed. We may ascertain, by observation, the precise amount by weight that is necessary to keep the body in a

properly nourished condition, but Nature's guide was in operation long before weights and scales were invented.

207. In taking appetite as a guide in regulating the supply of food, it must not be confounded with a desire to gratify the palate. When food is not eaten too quickly and the diet is simple, a timely warning is afforded by the sense of satisfaction, experienced as soon as enough has been taken, and not only does a disinclination arise, but the stomach even refuses, to allow this point to be far exceeded. With a variety of food, however, and especially food of an agreeable character to the taste, the case is different. Satiated with one article, the stomach is still ready for another, and thus, for the gratification of taste, and not the appeasement of appetite, men are tempted to consume far more than is required, and also, it must be said, often far more than is advantageous to health.

208. Far more evil is attributable to too much food being taken than to too little. It is only in comparatively small number of cases that the latter kind of evil is met with; whilst the amount of disorder, disease, and even curtailment of life, attributable to excess in eating and drinking, is unmeasurably great. Where the living is plain and simple, and the dictates of nature are followed, there is no need for weights and scales, but how many are there who would not be in an infinitely better state, if they lived upon a weighed and measured allowance of food and drink? Seeking for what is pleasurable instead of natural, the promptings of instinct are overruled, and it is the inclination instead of appetite that regulates what is consumed. Were it not for the temptation to exceed, induced by

the refinements of the culinary art, the physician's aid would be much more rarely required.

209. The maxim, that one should leave off with an appetite, or with the consciousness that more could be inconveniently taken, is a good one. Satiety is the first stage of excess. The effects of excess are shown in various ways, one of the most striking and constant results being an excessive increase of the fatty tissue of the body accompanied by disinclination for, and indeed diminished power of, movement. This state is particularly induced by eating food of starchy, oily, or fatty character, by indolent sedentary habits, and by exposure to a warm temperature. Some persons seem to accumulate fat, whatever be the nature of their diet, but, generally speaking, the tendency to obesity may be materially diminished by a careful adjustment of the quantity and quality of food to the amount of physical exertion.

210. The fact that great eaters are occasionally very thin, may be explained by the circumstance that from the stomach being constantly overtaxed, its digestive power becomes impaired and in consequence much of the food taken does not serve to promote nutrition.

211. Numerous illustrations might be adduced to show the importance of temperate living as a remedy for the most painful and obstinate forms of dyspepsia or indigestion. The following instance will answer the purpose. A captain of a merchant vessel, who had all his life enjoyed prosperity, had acquired the habits of intemperate eating and drinking, and was a victim to

chronic indigestion arising from constantly overtaxed digestive organs. In one of his voyages he was shipwrecked on the coast of a desert island. For thirty-six hours he had nothing whatever to eat; he and his son then knocked down a sea fowl which they tore in halves and devoured raw. For four months subsequent to this, he had nothing to eat but the eggs of different sea fowls. From the time of the first prolonged fast, and during the period that he was obliged to subsist on the simple diet just mentioned, he had no sensation of indigestion, and when he again reached his native land, the experience he had gained in adversity was not lost upon him, and he enjoyed a state of health to which he had long been a stranger.

212. We may notice that while the Creator has endowed man with appetites, the healthful tendency of which is to impel him to adopt the means necessary to ensure his subsistence, he has, at the same time, so constructed the human frame, that these appetites may not be abused with impunity. The effects of such abuse are exhibited not only in physical derangement, but in impairment of man's intellectual powers, and a deadening of his spiritual nature. The comparative infrequency, among the poor, of indigestion, and other diseases arising from over-indulgence at table, and to which the wealthy are such constant victims, might render the former more contented with their lot, by proving that the temperance, which they are compelled to practise, is directly and essentially conducive to their present happiness.

213. To trace out the effects of deficiency of food, all sorts of physical defects would have to be enumerated, and not a little of deficient intellect and abnor-

mal moral feelings. Our limits will not allow of any thing more, on this head, than the giving of one caution, viz., not to take it for granted that because a diet, stinted either by ignorance, asceticism, or weak digestive powers, produces no immediately sensible bad effects, such as wasting or debility, that it is therefore innocuous. It may, and indeed almost certainly will, either lay the seeds of future degenerative disease, or what is far more commonly the case, light up and stir into activity the dormant germs of inherited disease, which under a judicious and generous diet, might have withered in the bud, and eventually dropped out of the organism altogether.

214. What constitutes a sufficient diet? And how do so many persons remain in equally good health under the utmost diversity as to quantity, quality, and time of taking food? These two questions lie at the root of all systems of diet. They cannot be answered empirically, nor predicated for one person from the experience of another. For whilst the child of the wealthy citizen becomes pallid, and wastes away under a diet of the most nutritious substances—milk, eggs, meat, butter &c., the child of the agricultural labourer grows plump, healthy, and strong upon little else than coarse food, such as raggee and other dry grains and vegetables, and perhaps with fish and game whenever they can be got. So some people do very well with two meals a day, or even one good one and another very light, whilst others must have three, four, or even five meals, in the twenty-four hours. All this shows that more than the digestive organs are concerned in dealing with diet, and that the demands of the system at large upon the duties of those organs, must regulate the supplies submitted to their operation. There is but one rule as to quantity and that is,

the nutritive value, being equal, the supplies must equal the waste which depends upon activity of functions. Some persons, in performing similar amounts of labour, destroy more of their tissues than others, their bodily waste is greater, and they must have a greater bulk of food.

215. The quantity of food, which a grown up person requires to maintain himself in health and strength for work, has been computed at about thirty-two ounces of solids, and from two to four pints of drink daily. This is the result of extensive observation of persons whose diet, as well as their amount of bodily waste and exertions came under the inspection of competent observers. For persons who pass much of their time in inactivity, and for females generally, a much smaller quantity is consistent with health, and, generally speaking, those on the near side of forty-five eat and require more than those who have turned the corner of life.

216. The following dietaries are taken from among those of the Madras Medical Code. The signification of the letters heading the columns is as follows :—

N = Nitrogenous foods in ounces.

C = Carbo-hydrates, or
starches, sugars, &c. „

F = Fats or hydro-carbons, „

Sal. = Salts in grains.

For European soldiers in hospital,

Full diet.

Oz.	Foods.	N	C	F	Sal. in grs.
12	Beef or Mutton...	1.80	...	1.01	84
16	Bread...	1.30	8.13	0.25	91
12	Potatoes...	0.26	2.25	0.02	37
0½	Tea ...	...	...	...	..
1½	Sugar ...	...	1.42	...	...
6	Milk...	0.30	0.26	0.20	20
1	Butter ...	...	...	0.91	...
1	Onions ...	...	...	...	...
0½	Barley ...	0.05	0.35	0.01	4
0½	Flour...	0.05	0.34	0.01	4
0¾	Salt ...	...	...	...	156
Total...		3.76	12.75	2.41	396

Mixed diet.

Oz	Foods.	N	C	F	Sal. in grs
8	Mutton ..	1.20	...	0.67	56
8	Rice ...	0.50	6.21	0.06	17
4	Vegetables ...	0.05	0.48	...	12
8	Bread...	0.65	4.06	0.13	45
0½	Coffee ...	...	...	...	...
	Hoppers (6) ...	0.38	4.60	0.04	13
1	Butter ...	...	...	0.91	...
Total...		2.78	15.35	1.81	143

*For native prisoners in hospital
Full diet.*

Oz.	Foods.	N	C	F	Sal. in grs.
8	Mutton (for curry) ...	1 20	...	0·67	56
8	Rice... ..	0·50	6·21	0 06	17
0½	Curry-powder ...	..	..	..	..
4	Country vegetables ...	0·05	0·48	..	12
	Hoppers (6)	0·38	4 60	0·04	13
8	Bread	0·65	4·06	0·13	45
1	Ghee ... ..	..	..	1·00	..
1	Salt ... ..	..	..	..	416
Total...		2·78	15·35	1·90	559

Times of Meals.

217. Next to the quality and quantity of food, attention must be given to the mode of taking it. That the food should be taken with regularity, and at proper periods, is almost as necessary for the maintenance of health as that it should be of a proper nature and in proper quantity.

218. Carnivorous animals appear to thrive best upon food taken at long intervals. It is the custom in zoological menageries to feed the wild animals once a day only, and it is stated that they have been found, by observation, to do better when fed in this way than upon the same allowance of food given to them twice daily. Now, if we look to the habits of these animals, we notice that their mode of existence entails the occurrence of more or less protracted intervals between the times of feeding. Their supply

is precarious and irregular, having to be captured, as the opportunity presents itself, by the exercise of stealth and cunning. The food obtained is voraciously devoured to repletion, and then, from the heavy tax imposed upon the powers by the loaded state of the stomach, the animal remains for some time in a sluggish or inactive, and drowsy condition.

219. Such is the result where long intervals elapse between the periods of consumption of food. From the nature of the circumstances, it is a matter of necessity with these animals that this should be their mode of feeding. There are those amongst mankind, however, who are satisfied with one meal a day. But is it in conformity with our nature that our food should be taken in this way? In proportion to the length of the interval, must be the amount of food consumed at one time; and in proportion to this, will be the degree and duration of the inaptitude for the performance of any bodily or mental work. The feast of the glutton places him for a while in the position of the brute, which is by nature compelled to fill its stomach to repletion when the opportunity occurs.

220. The monks of a certain monastery, says Dr. Combe, make it a part of their religion to eat only once a day. While travelling, Dr. Combe was thrown in contact for three days with one of the order, and was surprised at the store of food consumed at each daily meal—a store appearing “sufficient to last a week instead of a day.” But, as in the case of the boa-constrictor, under similar circumstances, remarks Dr. Combe, “a deep lethargy immediately succeeded, and it was

not till four or five hours afterwards that his almost apoplectic features became again animated and expressive." This description of the monks may be found, to a great extent, applicable to certain religious sects, and widowed women among certain castes of the Hindus, who make it a point of their religion to take daily only one meal, which however mainly consists of vegetable substances with some milk, curds and butter, and which therefore is neither so stimulating nor capable of producing a sluggish and drowsy condition to the same extent as a meal into which animal substances principally enter.

221. Now looking to our relation to the supply of food, which involves no necessity for protracted intervals between the times of eating, and to the fact that our mental capacity constitutes our characteristic attribute, and that this is notably blunted after repletion of the stomach to the extent incurred where only one meal a day is taken, we have physiological grounds for considering such a mode of life as unsuited to our position.

222. With the vegetable feeders, we pass to an illustration of the other extreme. These animals, constantly within reach of their food as they are, pass a considerable portion of their time in feeding. We do not find that they gorge themselves at a repast so as to become placed in the same inactive condition as the carnivorous animal, but that they, instead, leisurely and frequently partake of the food within their reach. Is this, it may next be asked, the mode of taking food that is adapted for mankind? Experience shows that it is not necessary, and more-

over much of our usefulness would be lost by the time devoted to such a mode of taking food. Indeed, as we are designed by nature for a mixed diet, so it may be considered that the most appropriate mode of taking food is something between that adopted by the animal feeder and the vegetable feeder; and this happens to accord with the general practice of the majority of nations.

223. The prevailing custom among the majority of nations is for three meals of a substantial nature, to be taken during the day at intervals of about five or six hours' duration. Observation has shown that an ordinary meal is digested and passed on from the stomach in about four hours' time, and thus, the stomach is allowed to remain for a short period in a state of quiescence before it is filled with food again. Of course the frequency of meals and quantity eaten at each meal, will necessarily have reference to other circumstances. Those of vigorous constitution, who are addicted to laborious pursuits, may require three good meals a day; while for those of sedentary occupations, two moderate repasts will suffice.

224. The following simple rules are worthy of attention. First, remember that digestion, with most people, takes from three to five hours for completion; and it should not be interfered with by taking fresh substance into the stomach whilst that organ is engaged with a former meal. Secondly, like all other organs, the stomach requires rest after active exertion; a short time, therefore, should

elapse between the complete emptying of the stomach and refilling it. Thirdly, take notice whether your digestion is slow or quick; if the former, place a considerable period between your meals (these are the cases where two meals a day suit very well), say seven or eight hours; if it be quick, and perhaps imperfect, food must be taken in moderate quantity every four hours. Fourthly and lastly, remember that the digestion (of town people at least) is weakest in the morning, improves as the day proceeds, but after long and exhausting labour, becomes again feeble. The best meal of the day, therefore, should range between two and six o'clock.

225. The following table shows the mean time of digestion of some of the usual articles of diet.

Articles. of food.	Mode of cooking.	Time of digestion.	
		HRS. M.	
Rice ...	...Boiled	...	1 0
Sago ...	...Boiled	...	1 45
Tapioca ...	...Boiled	...	2 0
Beans ...	...Boiled	...	2 30
Potatoes ...	...Roasted or baked	...	2 30
Potatoes ...	...Boiled	...	3 30
Bread (wheat)	...Baked	...	3 30
Eggs (fresh)...	...Raw	...	2 0
„ ...	...Roasted	...	2 15
„ ...	...Soft boiled	...	3 0
„ ...	...Hard boiled	...	3 30
Butter ...	...Melted	...	3 30

Articles. of food.	Mode of cooking.	Time of digestion. HRS. M.
Cheese ...	...Raw ...	.. ... 3 30
Soup (chicken) ...	... ..	... 3 0
Soup (mutton) ...	... ..	... 3 30
Turkey ...	...Boiled ...	... 2 25
Mutton ...	...Broiled or boiled...	3 0
„ ...	...Fresh roasted ...	3 15
Pork ...	...Broiled...	... 3 15
Beef (lean) ...	...Roasted ...	... 3 30
Pork ...	...Roasted ...	... 5 15

226. In reading the above table there is a source of fallacy which ought to be guarded against. It is the supposition that because a substance is easily digestible, it must therefore be a desirable object of diet. The rapidity with which an article of food is passed out of the stomach is very often merely a mark of the small amount of nutriment to be got out of it, substances which are highly nutritious, on the other hand, being detained by the stomach until it has put forth all its powers to extract all their useful elements. On this account we are in the habit of calling certain foods satisfying, a term which generally means nothing more than that the stomach is engaged a long time upon them, and therefore the return of the feeling of hunger is longer deferred. Things may be slow of digestion, therefore, and cause some uneasiness in their assimilation, and yet be very nutritive, whilst others, although abounding in nutriment, may be irritating

to the stomach, or entirely beyond its powers to digest unaided.

227. It is important that we should break our fast, or, as the term goes, "breakfast," without much delay after rising. The length of time that elapses since the last meal of the previous day, leads to a demand for food for the ordinary purposes of life. The system, moreover, at a period of fasting is more prone to be perniciously influenced by infection, miasmata, exposure to cold, and other morbid conditions, and less adapted for sustaining fatigue than at any other time. In any case, therefore, where exposure to influences of this kind has to be undergone, it becomes of the deepest importance that food should be previously taken.

228. The size of the meal should be regulated by collateral circumstances. If food has been taken late in the previous evening, the appetite is not great for food in the morning. When considerable exertion has to be afterwards sustained, a substantial meal may be looked upon as advisable. Otherwise, however, a light meal will be found most conducive to health and activity.

229. As the system is exhausted in the morning, the stomach which is weak should be supplied sparingly with a gently stimulating rather than with too much solid food. This, and the loss of fluid through the skin during the night, call for a considerable allowance of liquid. Hence it is that coffee, as being more stimulating than tea, and, as

containing a larger quantity of milk and sugar, affording a more nourishing beverage, has become the favorite morning drink with many people.

230. Other meals. The meals which follow breakfast—dinner and supper—will take their character from it, and from the amount of wear and tear of muscle or mind which has to be undergone during the day.

231. The error is often made of omitting to take food in the middle of the day, or of only taking something very insignificant. There are many business or professional men who, after leaving home for their office or chambers in the morning, do not taste food, or, if they do, take only a minute quantity until they return in the evening. Actively engaged all day, the system becomes exhausted, and they arrive home in a thoroughly jaded or worn-out condition. They expect that their dinner is to revive them. It may do so for a while, but it is only a question of time how long this practice can be carried on before evil consequences arise. They begin to feel heavy, drowsy, and uncomfortable, after dinner, and no wonder, that they feel so, from the amount of food that becomes necessary to introduce at one time into the stomach to supply the wants of the system, and also from the exhaustion of power produced by the work performed, and the long abstinence from food. Vigour is required for digestion, equally as much as for muscular or any other work, and it is not to be expected that it can properly proceed under the state that has been described. Added to these indications that the digestive power is not equal to the amount of work thrown upon it, evidences of disordered action begin to show themselves. The sufferer becomes dyspeptic, and the heart and brain may sympathise with the derangement. It is, therefore, absolutely necessary that the interval should be broken by a

repast between an early breakfast and a late dinner, and no medical treatment will suffice to afford relief unless attention is given to this point. In many cases where indigestion forms the chief complaint, it will be found to have arisen from the neglect and non-observance of this simple rule of dietetics.

232. A heavy supper, especially if taken only a short time before going to bed, is generally bad. During sleep there is a diminished activity of all the bodily functions, and this condition is not favorable for the due performance of digestion. He who retires to rest with a full stomach, is fortunate if he escape passing a restless night, being troubled with dreams, and rising in the morning with a foul mouth. The supper, when supper at all is taken, should be, as far as practicable, made to approach to the early part of the evening, that is, supposing the usual hour for retiring to rest be observed; and when the engagements of life render such a course inconvenient, the meal should be light. The best arrangement for health is that the third substantial meal should be taken about six or seven in the evening. Opportunity is thus given for digestion to have approached completion before the night's sleep is begun.

233. The error of going to bed upon a full stomach has been alluded to. It is also equally unadvisable that the stomach should be in a perfectly empty condition. Fasting excites restlessness and watchfulness, and many a person has needlessly passed sleepless hours through retiring to rest after too long an interval since the last meal. The literary man, for example, who carries his labours far into the night,

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goes to bed with an empty stomach and finds that he cannot sleep. Let a little food, however, be taken, and it will be found to exert a tranquillising and comforting effect, and so will dispose to sleep.

234. *Diet of Infants.*—The importance of this branch of dietetics can scarcely be overrated. At no period of life is discreet management throughout so much called for as during the helpless condition of early infancy, and nothing constitutes so fruitful a source of infantile sickness and mortality as injudicious feeding.

235. The proper food during the first period of infancy is that, and that only, which has been provided by nature for the young of mammals, viz., milk.

236. It may be considered that, up to about the eighth month, the infant is designed to be sustained solely by its parent's milk. The teeth, which about this time begin to show themselves, indicate that preparation is now being made for the consumption of food of a solid nature, and the most suitable to begin with, will be one of the farinaceous products. Bread, biscuit, powdered rice, corn-flour, &c., may be employed for a time as a supplement to the previous food. Then, at about the tenth month, the maternal supply, which should have been already lessened, should be altogether stopped, and the child started upon the life of independence that is to follow. For a while, milk and the farinaceous products referred to above, will still form the most suitable food, but as the child advances in its second year, and the teeth become more developed, meat may be added.

237. Such forms the natural course to be pursued, but it often happens, either as the result of choice or of necessity—either because she will not or cannot—that the mother's part fails to be fulfilled. Under these circumstances, the question of the nature of the supply to be provided as a substitute, has to be decided upon.

238. Undoubtedly, the nearest approach to the actual food which has been designed to be given, is the milk furnished by another woman, and amongst the more wealthy classes this is often had recourse to. Now, in the selection of a wet-nurse, there are certain points which, in the interest of the infant to be reared, require to be attended to. It is scarcely necessary to say that the woman should be in a healthy condition and free from any constitutional taint. The most suitable age is from twenty to thirty. The milk should be sufficient in quantity and good in quality, and as its composition alters to some extent as time advances from the date of confinement, it is desirable that the infant should be nourished by a person who has given birth about the same time as its own mother.

239. Next, in appropriateness to the food supplied by a wet-nurse, comes the milk derived from one of the lower animals; and this may be employed either to make up for a deficient supply from the mother, or as the sole article of nourishment. The cow, goat, and ass are the animals which best answer the conditions required.

240. The milk of the cow gives the nearest approach to what is wanted, and it happens also that this in general is more easily procurable than that of any other animal. Cow's milk is richer in all its solid constituent principles, except sugar, in which it is poorer than woman's, and therefore slight dilution with water, and a little addition of sugar, will be all that is required to bring it to a sufficiently close approximation for serving as a substitute for human milk.

241. In children the peculiarity of nutrition is this: they have to take into their frames a larger amount of substance than they lose; at the same time the smallness of their organic development has to be considered. Their tissue waste is small, whilst growth is large. It is necessary, therefore, to watch the rapidity of growth, which is best done by occasionally carefully weighing them. The amount of development

of the intellectual organs must also be taken notice of. Wherever great activity is, there the supply of food ought to be liberal. Children should be kept to regular hours for meals, and made to eat slowly. The food of children should possess two qualities : it should be plain, yet easily convertible into nourishment : much of condiments, or spiced curries are injurious to children. Although they are building up the body apace, the digestive powers of the stomach have not yet reached their full development, and consequently those substances, which approach the nearest to the human frame in composition, should form the main portion of their food. Milk, eggs, and a moderate allowance of flesh-meat are good. The vegetable food should principally consist of bread, rice, and similar articles. Sugar and especially butter, are to be allowed in full quantity. As few young children can digest the fat of meat easily, sugar and butter are of prime importance in furnishing material for keeping up the heat of the body.

242. The frequency of meals for children under four years of age should be about every three hours in the day, and for those between that age and fifteen or sixteen, at about every four hours ; so four meals a day, and each of them should contain nearly the same bulk of solid food.

243. *Diet of Old People.*—Old people resemble children in the feebleness of their digestive organs, and the same rules as to frequency of meals and choice of food, are applicable in their case. Only in the case of old people, the stomach, which has lost its edge by life-long wear and tear, requires a more stimulating diet, or rather the addition of stimulating condiments and drinks to rouse its dormant energies. Thus they may take pepper and salt in milk, instead of sugar ; and curries and sauces, to give relish to the plainer food which they should use.

Circumstances Conducive to Digestibility.

244. Man by his hand or an appendage to this in the form of fork, spoon, &c., introduces his food into

his mouth. It is here cut, torn, and ground—in short, masticated—by the action of different teeth, while the movement of the muscles engaged in this process stimulates the salivary glands situated about the mouth, and causes a copious secretion of saliva from them. This fluid, watery in its nature, and containing a few salts and other matters, becomes mixed with the food, softens and reduces it to a pulp, and induces slight chemical changes in it. About half a pint of saliva is supposed to be secreted at each meal. Mastication is of the greatest importance to the subsequent digestion of the food, and should not be performed too hurriedly.

245. Eating slowly, by which every particle of the food may become intimately mixed with the saliva in the mouth, and dividing the food into very small pieces by the teeth, are great aids to digestion. The Germans are said to be slow eaters and they are likewise a healthy nation.

246. *Cleaning the teeth.*—Since the effective division of the food depends upon a sound condition of the teeth, we should keep these free from irritating matter, organic particles, tartar, &c. by careful cleaning every morning. Daily cleaning the teeth is a habit conducive to health. There is little need to advise the people of this country in this respect. But they should be warned against an abuse of this practice, for many of them are in the habit of cleaning their teeth with coarsely powdered brick, with cow-dung ashes containing all manner of rough particles,

and with hard sticks, and of rubbing their teeth with these rough materials for great lengths of time—sometimes for one or two hours. In not a few cases the consequence of this mischievous habit or practice is that their teeth are soon worn out and the men become, in the course of time, subject to some of the most painful and troublesome affections of the teeth. A mixture containing fine powder of common charcoal or burnt areca nut and a little of powdered common salt, will make a good and cheap material for cleaning the teeth. The gums and teeth will be strengthened by an occasional use of alum water.

247. Food, while being swallowed, is prevented from entering the wind-pipe (which of course would cause much distress and sometimes suffocation), by a firm valve placed over the entrance to the air-passage, which it closes most readily and effectually the moment food approaches it. Sometimes, however, the valve does not close quickly enough, and then substances get in and cause great irritation and coughing which lasts till the substance is expelled. This accident is very apt to arise from laughing or talking during eating; hence it is desirable to bear this important fact in mind. The habit of holding different articles in the mouth is, on the same account, dangerous; for they may be carried into the wind-pipe during inspiration and cause serious results and sometimes death.

248. It is necessary to rest for a while before eating, and to sit down to table with the mind free from care

and cheerful. Towards the latter condition, the society of relatives or friends, and cheerful conversation will materially contribute. The recourse to stomachics and bitters to provoke an appetite is to be avoided as likely to irritate the organ, and apt to degenerate into a habit. These and like tamperings with natural arrangements are indeed always objectionable. It is injurious to digestion to engage in any severe physical or mental labour immediately after dinner or any copious repast, and it is well to sit quietly for a short time, or at most, to occupy the mind with some light recreation.

249. A difference of opinion has been entertained by physiologists with regard to the effects of sleep after eating. The experience of most individuals, and the observation of what takes place among animals, would seem to prove that the amount of nervous power engaged in the digestion of a full meal, induces a sluggishness of other functions, and an inclination for quietude. For the weak and sickly, the very young and old, sleep after meals is frequently necessary and beneficial. Those of full habit should, however, cautiously avoid indulging in it, as being likely to induce congestion of the brain, and other disorders.

250 *Variety in Food*—Variety must be introduced into food, and different substances of the same class must be alternately employed. There appears no doubt of the good effect of variety, and its action is probably on primary digestion. Sameness cloy; and with variety, more food is taken, and a larger amount of nutriment is introduced. Although in some cases it is impossible to introduce any great variety of food, yet the same object may be secured by having a variety of cooking. The instinct for variety is founded upon laws of the economy which govern the whole act of digestion. By variety, the nerves of the stomach are excited, and they solicit to the

organ a greater supply of blood. All organs get accustomed to uniformity of stimulus, and their functions are then not fully called into action.

251. *Condiments.*—To certain sauces and seasonings, the office of which is to stimulate the various organs engaged in the process of digestion in order to promote that process, the term condiments is applied. Some of these have a higher action than that of mere local stimuli, and are nutritive in their character. Such are sugar and oil, whether taken by themselves as aliment, or added in comparatively small quantities to other aliments for the purpose of imparting flavour to them. Condiments have been classed, according to their properties, under the heads of saline, acidulous, oily, saccharine, aromatic and pungent. The saccharine, the oily, and the saline have already been noticed, and the rest require but a few words in passing.

252. The pungent and aromatic act as direct stimulants, and promote, through the nerves, the flow of saliva and gastric juice; they are required in very small quantities in cold countries, but are very necessary in hot climates, (where the organs partake of the general exhaustion induced by a high temperature,) to ensure such determination of blood to the digestive apparatus as is necessary to the due appropriation of a meal. The hotter kind of condiments which are so much used in the tropical countries are a great necessity of the climate, and nature has in this country placed the materials of the stimulating curry in close proximity to the insipid rice which no cookery can render palatable to the stomach without some savoury addition to it.

253. Spices and condiments form a very marked feature in all Indian dietaries. Without something to stimulate and excite the digestive organs, it seems probable that the large amount of grain taken into the stomach every twenty-four hours could not be assimilated. The condiments of the Indian dietaries appear to have the effect of exciting a suf-

ficient flow of gastric and salivary juices to soften the bulk of vegetable food, and thus help in its conversion into a material fitted for the nutrition of the body.

254. Chillies, black pepper, coriander, cardamoms, turmeric, ginger, garlic, onions, &c. are used by the grain-feeding population of India, in quantities which would astonish those who derive their sustenance from a less bulky but more nutritious diet. The natives of India are unequalled in the preparation of "chatnies," compositions of fresh fruits or vegetables, with salt, chillies, tamarind, onions, garlic, &c., and these often take the place of pickles in giving a zest to food. With the variously prepared chatnies and spiced curries, the Hindus give to the most tasteless food a piquant and appetizing flavour.

255. The addition of stimulating spices, condiments, &c., to substances, which already possess a natural and pleasant savour, is a dietetic blunder, being both unnecessary and injurious, as it is most probable that the savours natural to various dietetic substances are given to them for the purpose of exciting the nerves of the stomach so as to cause them to elicit a larger amount of gastric juice than would be produced by the contact of mere insipid aliments.

256. The acidulous class of condiments—vinegar, lemon juice, tamarind, &c., are agreeable and refreshing, and they assist the digestive action of the stomach.

257. *Cooking and Culinary Vessels.*—Our food, in order to be most beneficial to health, must be perfectly cooked, and cooked in proper vessels. Some of the culinary vessels used among the people of this country are quite objectionable and tend to injure health. Of these the worst are the leaden vessels. Natives of Southern India generally call

two distinct metals—lead and tin—by the same name of lead. They distinguish the one from the other by calling the former by the name of “dark lead” and the latter by that of “silver or white lead.” Culinary vessels made of the so-called “silver lead” or the properly named tin are quite harmless. But those made of “dark lead” i. e., the real lead, or of a compound of lead and tin, are decidedly objectionable. The lead poison, caused by the use of these vessels, does not produce any marked ill-symptoms at once, but gradually and imperceptibly accumulates in the system, and at length manifests its evil effects in the form of some serious maladies. One of these is a most painful and obstinate affection of the bowels known by the name of “Lead Colic.” This affection is also called “Painter’s Colic,” because it very often occurs among painters who constantly handle paints containing lead, and inhale the fumes rising from them. Another disease, caused by slow lead poisoning, is a kind of paralysis known as “Lead Palsy.” If brass and copper vessels are to be used for culinary purposes, they should be thoroughly and carefully tinned. The tinned vessels should periodically be inspected to ascertain whether the tin is wearing away the tin and impairing its efficiency. The tinning of copper and brass vessels should be renewed periodically. The copper poison, occasioned by the use of untinned brass and copper vessels, causes irritation of the stomach and bowels, giving rise to much vomiting and purging.

Drinks.

* 258. Thirst affords the best indication that the system is in want of a fresh supply of fluid, but in taking it we must be careful not to exceed the quantity required. When great waste is going on in consequence of excessive exertion, or exposure to a high temperature, a greater quantity or a more frequent imbibition of liquids than usual is necessary. It is desirable not to drink too copiously at meals; the greater part of fluid thus taken is no doubt directly removed from the stomach by absorption, but any excess must tend to dilute, to too great an extent, the food and probably also the gastric secretions, and thus interfere with the process of digestion.

259. It is important to regulate the temperature at which fluids are introduced into the stomach, since they are apt to cause mischief if either very hot or very cold.

260. When we consider the powerful sympathy into which the stomach is thrown, through its large supply of nerves, with other parts of the body, we shall see how it is that any powerful impression made upon it, as by a blow, by heat, or cold, not only affects the organ itself, but is communicated to other and more vital organs. We shall thus readily account for the instances in which sudden death has been produced by taking a copious draught of cold water when the frame has been heated and fatigued, although it is true that such a fatal result takes place only under peculiar circumstances, such as organic disease of the heart. The habit of eating ice upon a full meal is very apt, by reducing the temperature of the stomach, and causing a shock to its nerves, to impede the due performance of the digestive function. At the same time, ice

if eaten occasionally in hot weather in moderate quantity, and not too quickly, may prove grateful and agreeable.

261. Liquids, if taken at too high a temperature, are liable to injure the coats of the stomach, and impair the action of that organ.

262. Water is of all drinks the least objectionable, and the best adapted to the wants of the system. Water drinkers can reckon among their number a large proportion of those who have attained to extreme longevity, and who, at the same time, have exhibited sustained physical and intellectual vigour. For the inhabitants of hot climates, water is better adapted than any other liquid. At meals, water should be drunk in small quantities at a time. To take a large draught just before beginning to eat is injurious in two ways—first, it retards the flow of gastric juice, and secondly, it takes off the edge of the appetite by its bulk.

Coffee, Tea, &c.

263. It is a remarkable fact, that certain fluids have ever been in request among different nations for the effect they produce upon the nervous system and brain, and through these upon the intellectual faculties. Tea, coffee, chocolate &c. are eagerly sought after by man in different parts of the world. The Chinaman imbibes the pure infusion of tea leaves after every meal, and probably attributes to its qualities the conceived superiority of his own, over other races; the Arab and the Turk sip their coffee, and find in its stimulating action a pleasing substitute for the excitement of spirituous liquors, from which they are debarred by their religion.

264. The liquids prepared from these plants may be said to exercise not a little influence upon the intellectual life of

civilized man. The Frenchman's vivacity is brightened and his imagination warmed by the cup of strong coffee which he imbibes immediately after a meal ; the Englishman, rendered torpid by the concentration of his nervous energy upon the digestion of a full dinner, is again roused to life and action by one of these liquids. Independently of their effect upon individuals, tea and coffee take even a higher position in the social influence they have exerted upon communities. The tea table is still the rallying point towards the close of the day in most English families.

265. Volumes would be required were we to depict the change in the habits and manners of all classes of people in Europe since the introduction of tea and coffee. That social intercourse of an elevating character, extensive diffusion of a love for science, increased reliance upon self-help and individual exertion, to say nothing of the grand results of the ambition to excel, have had an intimate connection with tea and coffee drinking, with tea meetings, lectures, and mechanics institutes, no observant person can doubt.

266. These drinks—tea, coffee, chocolate &c., whose reputation is so general, and action so similar, owe their characteristic properties to the presence of a peculiar principle, which, in one and all, is nearly identical, and which further is supposed to be restricted to the plants from which these liquids are prepared. This fact would seem to show that these liquids are had recourse to for no mere idle gratification, but that they really supply a want in the physical life of man.

267. Of the effects of tea and coffee the most obvious are the excitement of the nervous force, with increased delicacy of perception, and the power of sustaining the attention beyond probably what can be attained by any other physical agent. It is especially in the latter part of the day that these effects of tea and coffee are most observable. When body and mind

are fatigued and jaded by any long and uninterrupted strain upon the powers, then it is that these liquids prove most refreshing and invigorating to the system. The muscular force returns, the mental perception and judgment clear, and attention is deepened and intensified.

268. These beverages are useful to all classes of society. To the active minded and studious they give the means of increased mental energy and perceptive power, and the manual labourer can, with their aid, do more work with the same quantity of food, or if food be deficient, can endure hard labour with less loss of muscular strength. When the diet is insufficient, coffee and tea limit very much the loss of weight thereby entailed. When the diet is sufficient, the body is more likely to gain weight when coffee and tea are taken than when they are not. Coffee and tea cheer and soothe the ruffled spirits, blunt the edge of carking care and sorrow, and enlarge the sympathies and tender emotions of the soul.

269. As a nervine stimulant, coffee or strong tea should not be given to very young children, as it tends to over-excite the brain, and in large quantity to bring on convulsions:

270. Green tea is more or less injurious in its action and therefore should not be used by itself. The effects produced upon many persons by a strong infusion of green tea, are of a distressing nature, such as extreme uneasiness of the stomach, nausea, trembling of the limbs, wakefulness and palpitation of the

heart. The habitual use of it gives rise to chronic indigestion, nervousness, and sometimes a state little short of general paralysis. Black tea should always be preferred to green, and it may be rendered sufficiently agreeable by the addition of a very small quantity of the latter. Tea or coffee should not be allowed to take the place of more nutritious and solid food, or drunk in such quantities as to interfere with the due performance of digestion, about half a pint twice a day, at the most, being sufficient.

Alcoholic Drinks.

271. We now approach the consideration of a class of substances usually regarded as foods and which are of perhaps greater importance, in their effects upon a community, than any other class of substances, and whilst they afford pleasure and health to some, give pleasure, disease, and misery to many.

272. Alcoholic drinks present themselves under the two heads of fermented liquors—beers and wines—and spirituous liquors or spirits.

273. The different kinds of beer in vogue are fermented decoctions of malt (which is prepared from barley) and hops—a bitter plant. The principal varieties of beer are ale, stout, porter, and bitter and table beer. All of these contain a certain quantity of alcohol, which varies from 6 or 7 per cent., as in strong ale or stout, and 4 or 5 per cent. in porter, to $1\frac{1}{2}$ per cent. in table beer; they also contain sugar and gluten which render them nutritious, carbonic acid which gives pungency, extractive matter, various salts, acetic acid, and a large proportion of water.

274. Strong ales and stout are not well suited for ordinary drinks, on account of their intoxicating character, and they are rendered further prejudicial by the adulteration *Coccus Indicus* (or the Hindustanee Kackmarike Beenj) which is a

poisonous fruit or berry, added to beer in order to increase its intoxicating quality.

275. Beer is a refreshing, exhilarating, nutritive and, when taken in excess, an intoxicating beverage. Its nutritive properties are due to the extractive matter, consisting principally of carbo-hydrates which it contains, and the beer, which is highly charged with extract, exerts a decidedly fattening influence. Its bitter principle renders it a stomachic and tonic. A light beer, well flavoured with hop, is calculated to promote digestion, and may be looked upon as constituting one of the most wholesome of the alcoholic class of beverages. Light bitter ales, commonly known as bitter and table beer, are free from the objection which attaches to the stronger kinds of beer, and are suited for those of weak digestion. It is not all, however, who can drink beer without experiencing inconvenience. In the case of persons of a bilious temperament, also with dyspeptics, and sometimes others, it is apt to excite headache, heaviness and other sensations, which fall under the popular designation of "biliousness." The stronger beers, taken continuously in excess, induce a full and plethoric condition and are liable, particularly if conjoined with sedentary habits, to result in the production of various diseases and disorders.

276. Wines result from the fermentation of saccharine juices derived from different parts of different plants; from the roots of some, the stems or leaves of others, and the fruits of many more. The grape is the most generally employed in the production of wines. All wines contain certain characteristic constituents in various proportions. The most important of these constituents is alcohol or spirit, which varies in quantity from 10 to 20 or 25 per cent. Those wines as Claret, Hock, and Moselle, which contain but little spirit, are called light wines; while Port, Sherry, and Madeira, which contain a large percentage of alcohol, are called strong wines.

277. For those who are delicate and constantly exposed to the artificial influences of town life, and who also take much bodily exercise, a moderate use of some good wine may give a salutary impulse to the nervous system, promote the digestive process, and impart permanent strength and benefit by ensuring a more effective assimilation of solid food. But for persons in full health and vigour, it must be admitted that this class of drinks is to be regarded as a luxury rather than a necessity. The habitual imbibition of wine renders it a necessity; and in order to relieve some temporary depression, there is an unfortunate aptitude with many people, to creep on insensibly from smaller to larger quantities.

278. Spirituous liquors or spirits are derived from the distillation of fermented saccharine juices. The principal ardent spirits are,—*brandy* which is distilled from the fermented juice of the grape; *rum*, from the fermented residue of the juice of sugar-cane, and from molasses; *gin* prepared from corn spirit and flavored with juniper berry; *whisky*, obtained from malted barley or other grain; and *arrack* which is distilled from the fermented palmyra jaggery, or palmyra or cocoanut toddy.

279. Spirituous liquors have properly speaking nothing to do with the subject of health, and should never be used but as remedial agents, and under medical direction. The use of spirits are the most injurious in hot climates.

280. It will be said that alcohol cheers the weary, and that, to take a little wine for the stomach's sake is one of those lessons that comes from the deep recesses of human nature. There are, indeed, times in the life of man when alcohol is found of invaluable service, so much so that it may be justly reckoned amongst the most excellent gifts of nature to mankind. Unhappily, the border line between its use and abuse, the temptation to extend beyond the use, the habit to apply the use when it is not wanted as readily as

when it is wanted, overbalance in the multitude of men the temporary value that attaches truly to alcohol as a physiological agent. Hence, alcohol becomes a dangerous instrument even in the hands of the strong and wise, and a murderous instrument in the hands of the foolish and weak. Used too frequently, used too excessively, the agent, that in moderation cheers the failing body, relaxes its parts too extremely; spoils vital organs; makes the course of the circulation slow, imperfect, and irregular; suggests the call for more stimulation; tempts to renewal of the evil; and ruins the mechanism of the healthy animal before its hour for ruin, by natural decay, should be at all near.

281. Let us now consider some of the effects which result from the abuse of alcoholic liquors, under which title are comprised beer and wine, as well as ardent spirits.

282. Permanent effects of habitual intoxication or inordinate use of alcoholic liquors, show themselves on almost every organ of the body.

283. The stomach is one of the organs which become injured by habitual drunkenness. Chronic diseases of this organ very commonly occur among drunkards, who become the constant victims of indigestion, and either habitually reject or have a total aversion for food, and thus, from want of due nutrition, become the miserable emaciated objects that we frequently see them.

284. The liver is another organ, diseases and disorders of which (such as hepatic inflammations, enlargements, or degenerations and jaundice) are among the permanent effects of the abuse of spirits.

285. It is however upon the nervous system and the brain that the most serious permanent effects of drunkenness are produced. The most melancholy affection of the brain resulting from habitual inebriety is known as *delirium tremens* which supervenes when the system is depressed from disease, or

anxiety, or when the supply of ardent spirits is suddenly cut off. This affection is marked by great depression of the vital powers, by a peculiar agitation and trembling of the limbs, and by a derangement of the intellectual powers amounting to delirium. This delirium is associated with a peculiar apprehension of evil, and is generally characterized by striking illusions of the senses. For instance, it is related of a military man, who, on one occasion, was attacked during the night with visions of war, that he fancying himself surrounded by enemies, got out of bed and did battle, till the morning, upon the table and chairs. The most distressing feature of delirium tremens is protracted wakefulness, and an entire want of sleep, so that if sleep be not ensured after a time by some adequate means, as giving opium, or chloral, the individual may die of nervous exhaustion.

286. Another affection of the brain induced by drinking is mania; and it has been calculated in England that, of the cases of madness occurring in the lower classes, at least 15 per cent are traceable directly to this cause; while, of those occurring in the middle classes, about 10 per cent have this origin. Of those who do not become permanently maniacal, some are attacked, after drinking, with fits of madness, in which they frequently do violence to their fellow-creatures; while others, and these of the more cultivated class, fall into drunken melancholy. While carried headlong by their fatal passion, they are keenly conscious of their excess, measure the abyss in which they are plunged, and, in the struggles of faltering reason, are impelled by despair to suicide. Drunkards frequently leave madness or imbecility, to say nothing of their destructive habit, as a legacy to their offspring; thus fearfully are visited "the sins of the fathers upon the children." The habit of inordinate drinking confirmed into a necessity, the almost irresistible longing which impels the miserable victim to complete his ruin, has been described by some writers as a monomania. The power of exercising the will is almost

lost, and the hope of recovery is indeed faint. Every man should therefore, by timely exercise of his self-agency, avoid falling into such a gulf of perdition.

287. The effect produced by drunkenness upon the mind and moral affections of the individual addicted to it, is very remarkable. If the intellectual faculties are at first excited, and even rendered temporarily more vigorous by the stimulus of alcoholic drinks, the continued abuse of these tends to their enervation. Many a man, possessed of brilliant abilities and prospects in early life, has, before his career has reached its meridian, either stimulated himself into madness, or degenerated into a confirmed melancholiac, or into a state little better than that of an idiot. Again, how utterly is the moral nature degraded, the temper embittered, and the gushing affections of man sapped in their very source, by this degrading habit. Not only does the drunkard disregard the distinction between right and wrong, strict adherence to truth, right of property, and the many high obligations to himself, his fellowmen, and his God, by which religion and morality should bind him, but his perverted sense renders him callous to matters which concern his own temporal interest, and to the welfare of those who should be most dear to him, and he plunges himself and those who depend on him for support, into the lowest depths of misery. When we consider the various ills, physical and moral, that are the consequences of the inordinate cup, we may well exclaim with the great dramatic poet, "O! that men should put an enemy in their mouths to steal away their brains! that we should with joy, pleasure, revel, and applause, transform ourselves into beasts!"

288. Again old age prematurely overtakes the drunkard; the young man of thirty who has given himself up to drinking, often has the grey hairs and wrinkled aspect of the very aged.

289. If we regard drunkenness in its relation to communities, we shall find that it is the most prolific source

of every social evil. A judge is reported, on one occasion, to have remarked to the grand jury;—"If it were not for this drinking, you and I would have nothing to do." Another writer says that, "Four-fifths of the crimes committed are said to be directly traceable to this cause, and of the remaining fifth, a part, are indirectly the result of it. Drunkenness is also the cause of most of the extreme poverty, and of the physical misery and spiritual degradation of the lower classes." There is much truth in what has been said by another writer that, "If alcohol were unknown, half the sin and a large part of the poverty and unhappiness in the world would disappear." By depressing the vital powers, and by the filthy habits which it engenders, it becomes a ripe source of fever, and a serious aggravator of epidemics; and thus, as in other ways, is the great obstacle to the social and moral elevation of the poor.

290. A report on the census of America in 1860 has the following remark: "For the last ten years the use of spirits has, (1) imposed on the nation a direct expense of 600,000,000 dollars; (2) has caused an indirect expense of 600,000,000 dollars; (3) has destroyed 300,000 lives; (4) has sent 100,000 children to the poor houses; (5) has committed at least 150,000 people into prisons and work-houses; (6) has made at least 1,000, insane; (7) has determined at least 2,000 suicides; (8) has caused the loss, by fire or violence, of at least 10,000,000 dollars worth of property; (9) has made 200,000 widows and 1,000,000 orphans."

291. Another writer says that alcohol kills certainly in its own way to the extent of fifty thousand persons a year in England, and ten thousand a year in Russia, but its method of killing is slow, indirect, and by painful disease.

292. In intemperate persons the mortality at 21—30 years of age is five times that of the temperate; at 30—40 it is four times as great. It becomes gradually less.

A temperate person's chance of living is at 20 about 44 years.				An intemperate person's chance of living is at 20 about 15 years.			
„ 30	„	36	„	„ 30	„	13	„
„ 40	„	23	„	„ 40	„	11	„
„ 50	„	21	„	„ 50	„	10	„
„ 60	„	14	„	„ 60	„	8	„

293. All these deductions appear to be drawn from observations on 357 persons with about 6,111 years of life. The facts connected with these persons are well authenticated.

294. The average duration of life after the commencement of the habits of intemperance is—

among mechanics, and working and labouring men, 18 years.

„ traders, dealers, and merchants 17 „

„ professional men and gentlemen 15 „

„ females... .. 14 „

295. Those who are intemperate on spirits have a greater mortality than those intemperate on beer. Those who are intemperate on spirits and beer have a slightly greater mortality than those intemperate on only spirits or beer ; but the difference is immaterial.

296. Impressed by the fearfully demoralizing influence of drunkenness upon individuals and on society at large, believing that all half measures have utterly failed in eradicating the vice, urged moreover by the conviction that alcoholic liquors are in no way necessary to the support of the human frame—disinterested philanthropists have, at different periods, endeavoured to lead their fellow-men to practise teetotalism or total abstinence. Mahomet, knowing the warm temperament of his countrymen, and the serious consequences upon them of abuse of intoxicating drinks, made entire abstinence from these, one of the principles of his religion. His followers, at least nearly the whole of them, numbering many millions, and spread over part of Europe and a large extent of Asia and Africa, still adhere to this principle.

297. All that has been hitherto urged against alcoholic liquors has had reference to their abuse, and while conscious of the physical and moral amelioration that has been effected among many, especially of the lower classes, by total abstinence—while admitting that such entire abstinence is the only hope for those, whose sense of right, and strength of will are unequal to restrain them from excess, and that it affords the sole faint chance for the drunkard—while giving all honor to the disinterested philanthropists, who, by earnest exhortation, and still more by the force of example, have endeavoured to promote the cause—we must still admit that the temperate use of fermented liquors is not opposed in any way to the well-being of man. Ardent spirits, as we have already observed, should never be had recourse to, save in extreme cases or for remedial purposes.

298. It will, perhaps, be argued that when the human body is in perfect health and vigour, and when its natural conditions are fully realized, no stimulus is needed, or should be had recourse to. But the truth is, that, in consequence either of some inherent constitutional weakness, from the depressing influence of his peculiar and unavoidable mode of life, or from the halo of artificiality by which, especially in towns, he is surrounded—man, in a large number of instances, cannot be regarded as living in a state of nature or as being in a normal condition of health. His system requires some moderate stimulus to counteract the various depressing causes to which it is exposed. Further, in consequence of the highly nervous character of the human constitution, and from the remarkable influence exerted by the mind over the body, certain agents may be required by man, the necessity for which would not be felt by a creature more purely animal.

299. It is especially the artificial habits of society that are to be charged with a great deal of the necessity for the use of stimulants. Irregularity in the time of meals, and of the

quantity of food taken at them, by deranging the digestion and producing bodily exhaustion, leads in many cases to the use of stimulants. Again the excessive cares and anxieties, and the hurry and worry of business, the over-competition and the hard struggles in literary and other pursuits, which seem to characterize these modern times, produce such an amount of nervous exhaustion and depression of spirits at times, as to create a want or necessity for moderate use of some stimulants. It follows, therefore, that wine, tea, coffee and other agents, the use of which is sanctioned by the habits of mankind from time immemorial, must not be rejected as unnecessary, simply because we cannot reduce their action to some chemical "rule of three."

300. Wherever the human race exists, even in the most primitive and uncivilized condition, the art of producing intoxicants is known and practised in some form, however rude and barbarous. In India, the use of nervine stimulants has been coeval with its history. Opium, Indian hemp, and betel nut have been used by the people from time immemorial, and in more recent years, the tobacco plant has been cultivated throughout the length and breadth of the land. If the people generally take a less quantity of fermented drinks than do those of temperate zones, they certainly make up for the omission by the habitual use of betel, tobacco, opium and hemp.

301. There is no question, that there is an innate craving in the human constitution for something which has the effect of calming and soothing the nervous centres. These portions of the human frame are more and more called upon for exertion in the countries where civilization is progressing with rapid strides.

302. The appetite for stimulants, as a late writer has observed, seems to be one "which like the other faculties, is given to different men in different proportions, and is subject

like them to the organic laws. It grows with use, and lessens with disuse. It can be inherited and transmitted. Moderately indulged in, it is sanitarily and socially a blessing ; immoderately, it becomes a curse to its victim, and a social pest."

303. It appears, then, that physiology and experience, and assuredly also the precepts of religion, offer no objection to the moderate use of the various good things which Providence has furnished for us, and among them, of the "wine that maketh glad the heart of man."

304. The great lesson to be inculcated, in respect to eating as well as drinking, is temperance. In order to bring the body into the highest degree of vigour, as in the process of training for different athletic exercises, the strictest temperance is necessary, and St. Paul uses this fact in illustration when he says :—" Every man that striveth for the master, is temperate in all things." Early rising and early going to bed, regular exercise not extended to fatigue, the moderate use of nutritious food and of fermented liquors, and abstinence from ardent spirits, and severity of mind, are the conditions scrupulously observed in the training of the athletic, and, although our object should be merely so far to invigorate the body that it may be a useful servant to the controlling mind, attention to such conditions will prove to us of incalculable benefit.

CHAPTER V.

PERSONAL CLEANLINESS, BATHING, AND CLOTHING.

305. SITUATED in the cellular tissue beneath the true skin, is an amazing number of small glands, which may be arranged in

two sets each set being charged with a peculiar function. To the set which we shall first notice, the term sebaceous or oil glands is applied. These glands are most frequent on the head, face, and in the folds of joints. They secrete an oily fluid which imparts a shining appearance to the hair, a soft velvety character to the skin, and a peculiar odour to the body. This secretion is most copious in the folds of joints, where it prevents undue friction and facilitates movement. Moreover it lubricates the surface of the skin, and protects it against the drying influence of the sun and wind, especially in the dark colored races inhabiting the tropics, in whom these glands are far more numerous than in the natives of temperate climates.

306. The other set of glands are called sudoriferous or perspiratory. They are very small, varying from a 30th to a 6th of an inch or more in diameter. They are globular or oval in shape, and consist each of a duct considerably twisted, and which passes out in a spiral course to the surface of the skin, the orifice or mouth being protected by a delicate prolongation of the scarf skin. The apertures of these perspiratory ducts, may, in some parts of the body as the palm of the hand and sole of the foot, be seen with the naked eye. It is said that there are about 3,528 of these in a square inch of the surface of the skin, on the palm of the hand the average being 2,500 for every square inch, making a total of about (7,000,000,) seven millions throughout the body. Each tube when straightened out, is about a quarter of an inch long, so that if all the perspiratory tubes of the body could be placed end to end in a line, they would extend to 1,750,000 inches or little less than twenty eight miles. The secretion of the little glands last described, is known as perspiration. Although unnoticed by us, this is always passing off from the body in the form of vapour. If the hand be held at a very trifling distance from a mirror, the vapour will soon become condensed upon the glass, and make it more or less dim. When the secretion is

much increased, the perspiration passes off as a liquid, and becomes sensible to us.

307. During the whole period of life, the bodily organization is in a state of constant decay and renovation, and when any suspension of, or derangement in, these processes occurs, the health immediately suffers, and fatal consequences are often the result. The skin, the kidneys, the bowels, and the lungs, constitute the channels or outlets by which the waste and effete matters of the system are removed, and of these the excretion or throwing out by the skin is by far the most abundant. Taking even the lowest estimate, we will find the skin entrusted with the important charge of removing from the system about two pounds of waste and useless matters every twenty-four hours.

308. We can thus see an ample reason why checked perspiration should prove so detrimental to health,—because, for every twenty four hours during which such a state continues, we must either have a large amount of useless and now poisonous matter accumulating in the body, or have some of the other organs of excretion, greatly overtaken to do the work of the skin by throwing out of the system the poisonous matters which ought to have passed out in the form of perspiration. When an excretory organ thus undertakes to discharge the function of another in addition to its own this cannot obviously happen without more or less of disturbance in the regularity and well-being of the over-tasked organ. People know the fact, and wonder that it should be so; that cold, applied to the skin when the body is inactive, or continued exposure in a cold day, often produces a bowel complaint, a severe cold in the chest, or inflam-

mation of some internal organ. But, were they made aware of the structure and uses of their skin, they would rather wonder that the error did not always produce one of these evil results.

309. In tracing the connexion between suppressed perspiration and the production of individual diseases we shall find that those organs which possess some similarity of function sympathize most closely with each other. Thus the skin, the bowels, the lungs, the liver, and the kidneys sympathize readily, because they have all the common office of throwing waste matter out of the system, each in a way peculiar to its own structure; so that if the exhalation from the skin, for example, be stopped by long exposure to cold, the large quantity of waste matter which it was charged to throw out, and which in itself is hurtful to the system, will most probably be thrown upon one or other of the abovenamed organs, whose function will consequently become excited; and if any of them, from constitutional or accidental causes, be already weaker than the rest, its health will naturally be the first to suffer. In this way, the bowels become irritated in one individual and occasion bowel complaints; while in another, the lungs become affected and give rise to colds, coughs, and other chest complaints, and in a third, the kidneys are deranged. When, on the other hand, all these organs are in a state of vigorous health, a temporary increase of function takes place in them, and relieves the system, without leading to any local disorder; and the skin itself speedily resumes its activity, and restores the balance among them.

310. While a partial obstruction to the performance of the functions of the skin will often induce certain diseases and disorders more or less serious, a complete obstruction to the same, as by means of an impervious coat of varnish applied to the skin,

will at once destroy life. To illustrate the latter point, the celebrated case of the child gilded with gold leaf by order of Pope Leo X may be mentioned. On some occasion of great solemnity this Pope caused a young child to be completely covered with gold leaf closely applied to the skin, so as to represent, according to the idea of the age, the golden glory of an angel or seraph. In a few hours after contributing to this pageant of pride the child died, the cause being suffocation from stopping the exhalation of the skin (especially the poisonous matters of perspiration), although in the ignorance of those days, the death was of course attributed to the anger of the Deity, and looked upon as a circumstance of evil omen.

311. We can now understand the importance of promoting, by unremitting care and attention, cleanliness of the skin by the free performance of its functions. To secure this object we have ever a ready means at our service in water. By the free and habitual application of water, the skin may be kept pure and supple, freed from the animal matters deposited from its secretions, and from extraneous particles of dirt. If ablution coupled with friction be not regularly practised, the delicate ducts of the perspiratory and oil glands of the skin will become blocked up. To form a practical acquaintance with the nature of such obstruction to the functions of the skin and with the character and quantity of matters deposited on it, we need only glance at the

surface of the bath on using it after a few days' neglect of the skin.

312. The positive good, in the form of healthful vigour, buoyancy and cheerfulness, arising out of habits of general cleanliness, is very great. The daily ablution of the entire surface of the body will conduce to much comfort and happiness during the day.

313. The old adage that cleanliness is next to godliness must have had its origin in the feeling of moral elevation which generally accompanies scrupulous bodily purity. Personal cleanliness, when grown into a habit, draws after it so many excellences, that it may well be called a social virtue. Without it refined intercourse would be impossible, for its neglect not only indicates a want of proper self-respect, but a disrespect of the feelings of others, which argues a low tone of the moral sense. All nations, as they advance in civilization and refinement of manners, pay increased attention to the purity of the person.

314. The typical washing or bathing must be based upon the following three objects. The first is to remove dirt, and open the pores of the skin, the second is to refresh the system generally, and the third to soothe the nerves of the skin and prevent cutaneous eruptions. To effect all these objects, some clean and soft water, mild soap or any similar material (for occasional use only), two towels—a soft and a rough one,—and ten or fifteen minutes of time are the only requisites.

315. According to the temperature of the season or other circumstances, cold, tepid, or warm water will be required. Morning, soon after rising from bed, is the best time for bathing. Bathing, which need

not occupy more than a few minutes, is to be succeeded by gently drying the skin with a soft towel, and when it is quite dry, a rough towel or, in some cases, the flesh-brush, is to be passed rapidly over every part of the body for four or five minutes more, by which time the skin will assume a reddish tint (at least in persons of fair skins) and glow with warmth. The chest and abdomen and the joints of the lower limbs should receive the principal rubbing. The roughness of the towel must be accommodated to the condition of the skin. For children, women, and men of delicate and irritable skin, nothing harder than a common towel is needful. For the pale or darker skins, a Turkish hand-rubber, and for persons who are easily chilled, or with cold extremities, the flesh-brush, will be most useful. Anyhow, a gentle warmth must be produced, otherwise the person will feel chill and languid for some time afterwards.

Cold Bath.

316. Cold baths are naturally furnished for us in rivers, lakes, and in the ocean, the waters of which are less readily heated by the sun's rays than is the air, and generally have a temperature some degrees below that of the air. Climate and season, of course, materially determine the temperature of the cold bath. The first effect produced by plunging into cold water is familiarly known as the shock. The dense medium—the water—bears heavily upon the chest and rest of the body; the cold drives the blood from the surface to the internal organs, causing contraction and paleness of the skin, and inducing chilliness, shivering, chattering of the teeth and

even convulsive sobbing. If the system is vigorous, the shock serves but as a stimulus to the heart which rebounds as it were, takes on increased action, and throws back the blood over the surface. A glow and sense of warmth ensue, the pulse becomes quicker and fuller, perspiration oozes out from its invisible pores, and reaction, as it is termed, is fully established. This and this alone is the secret of the beneficial effect of cold bathing. If this effect be not produced, then nothing but evil will result from its use. This condition is hastened by movement, particularly by swimming, and is maintained if the immersion be not too long continued. From five to twenty minutes is a sufficiently long time to remain in the water, but swimmers, from the powerful exercise they take, may remain longer. The bath may be preceded by a walk, and it is important to observe that the popular notion of waiting to get cool before plunging in water is erroneous. Excessive heat and perspiration are objectionable, but it is better to take the bath when the body is warmed and somewhat excited by exercise, for it is then in a more favourable state to resist the shock, and establish reaction. Experience supports this view.

317. Cold baths repeated regularly produce an invigorating effect. Among the favourable results are increased capability of enduring fatigue, more vigorous performance of the functions of the body, improved appetite and digestion, and augmented elasticity and force. In warm climates and seasons, the cold bath acts as a refrigerant, abstracts the undue heat of the body, and lessens the necessity for, and amount of, perspiration.

318. The proper temperature at which to take a cold bath depends upon the object in view. If it be

used to invigorate a weakened system or part, the shock must be of short duration, and followed by long continued friction to insure complete reaction. Weakly persons, especially weakly boys ambitious of doing as others do, run great risks and indeed often increase their debility by inattention to this rule of bathing. The sudden plunge is undoubtedly the best for strong people, but it is too severe for the delicate. With these, the face, neck, and chest should be first wiped over with the towel well wetted in the bath, and then the whole body may be immersed. It is very bad to get into the bath and stand in it with the water only covering the legs and lower parts of the body. By so doing, the heart and central organs become so highly congested with blood that perfect reaction is beyond their powers, and cold extremities, languor, and chill continue for many hours, debilitating the muscles and depressing the mind.

319. Persons of weak constitution may not be able to establish effective reaction after a cold bath. In such, the bath is succeeded by a prolonged sense of chilliness, by languor, oppression, headache, and drowsiness. It is by the presence or absence of the reactionary glow, that we must decide, in any particular case, whether the cold bath is objectionable or not. It is advisable for those who are not strong to bathe three or four hours after breakfast. The water is then warmer, and the system more fortified than in the early morning.

320. To enjoy a cold bath, the old direction of Galen should be adopted—viz., To rub the surface of the body gently for a few minutes before immersion. In this way the pleasure of the contrast from heat to cold will be enhanced, whilst all danger of prolonged stay in the bath will be removed. The dressing after the bath should be performed as rapidly as possible to prevent undue evaporation from the surface, and liability to cold; and a good rubbing all over the body for a few minutes with a rough towel or a brisk walk, by way of a finish, will maintain the reaction and genial glow of the skin. Cold bathing is inapplicable in very cold weather, and to persons in very delicate health and of weak circulation.

321. *Sea-bathing.*—The peculiarity of sea-bathing consists in the low temperature of the water, and in the friction of the body and muscular exertion caused by the movement of the waves. Its saline character renders the water more stimulating and brings about a speedier and more prolonged reaction.

322. The bracing air and the expanded ocean, contribute to the effect; for the mind has its share in these recreations. There are indeed few enjoyments more exciting than a plunge into the sea on a calm clear day, with the glittering emerald surface spread out before us, and the glorious blue canopy overhead.

323. Sea-bathing is not likely to be undertaken by any but the comparatively strong, except under medical advice. Sea-bathing is used altogether as a stimulant. If it do not act as such, it should be at

once abandoned. As the stimulating effect is due, in a greater degree, to the first shock, than to the effects of the saline ingredients of the water, none should use it who cannot bear the shock which the sudden plunge produces. Invalids and aged persons, and those of a very nervous temperament, had better content themselves with a salt-water bath at home, than venture into the sea ; at all events, until they have become accustomed to the sudden change caused by cold water.

324. The proper method of taking a sea-bath is that which will ensure the greatest reactionary effect from the first shock. Immediately on plunging into the water, brisk motion of some kind should be used. Those who can swim should do so ; those who cannot, and ladies, and children, should make as much exertion of the limbs as possible, or rub the body with their hands. Very soon after the first immersion, a reaction takes place, and the giddiness and breathlessness of the first moments are succeeded by a universal glow, a lightness and buoyancy of the limbs, and a brave and joyous feeling of the mind. So long as these sensations remain, the bather may safely enjoy the sport of battling with the waves, but on the first hint of their subsidence, he should leave the water, and not expose himself to that second depression which is caused by the abstraction of too much of the heat of the body, and consequent failure of the vital force. The strong should not neglect this rule ; otherwise, instead of the vivacity of mind and springy nimbleness of the body which ought to be the permanent

effects of the bath, languor, sleepiness, and bodily weariness will hang about them for the remainder of the day, and perhaps for a longer period. The delicate, and particularly those who are recovering from illness, should remain a still shorter time, and remove from the bath as soon as the glow arrives, or, if that be not felt at all, after one plunge. These latter should on no account dress themselves until they have, by friction with a rough towel or the flesh-brush, restored the circulation to the skin, which ought to become more or less of a reddish hue.

325. *Tepid Bath* has a temperature of from 85° to 92° . It is well adapted to purposes of cleanliness, gently promoting perspiration and refreshing the system. It may be used when the weather is very cold, or when the powers of the body are depressed, or in the case of delicate women and children. After severe exercise in the heat, or in the rain, when the joints are stiffening and the body feels chilly, a rapid tepid bath or simply washing of the whole surface, with tepid water, is extremely refreshing, and in some cases the only safe bath.

326. *Warm Bath* has a temperature which ranges from 92° to 98° . It is desirable to take it at 97° or 98° (the heat of the human body) ; if lower, it fails in its purpose; and if higher, it induces languor and oppression. Its first effect is to increase the heat of the surface, and it accelerates the respiratory movements and action of the heart. After a short time moisture breaks out on the forehead and face, copious

perspiration ensues, and the system is relieved. Immersion for ten minutes or a quarter of an hour is sufficient, languor, diminished muscular power, and faintness being the consequences of remaining longer in it.

327. If the warm bath be taken too frequently, it has a relaxing effect; but its occasional use is conducive to health. It softens the skin, effectually frees it from impurities, renders the limbs more supple, and promotes perspiration. It should not, however, be allowed to interfere with the practice of daily ablution in cold or tepid water. The warm bath is better suited than the tepid or cold to very young infants, on account of the inability of their system to resist sudden change. It should be used only at 97° or 98°, the temperature to be tested by the thermometer and not by the hand.

328. The robust and healthy have no occasion for the warm bath, except under peculiar circumstances. After great fatigue, injury, sprain, or over-tension of the muscles, a warm bath is the proper remedy. Also after exposure to the drying effects of travel particularly in hot or violent winds, warm bathing will act as the best restorative. The first access of a cold may also be successfully treated by a prolonged warm bath.

Clothing.

329. For the protection of the human body against cold and heat, rain and sunshine, some proper clothing is necessary, because man's skin is fine, soft, and smooth, and he is not provided, like the inferior animals, with any natural covering, such as hair, feathers, or scales. Although man was placed upon the earth a naked and defenceless being, not supplied with any natural covering, yet the all-

wise Creator has bountifully endowed him with intellectual faculties, by the exercise of which he is able to subdue the forces of nature and make them subserve his wants. He can design and fabricate suitable clothes for himself to protect his body. But the lower animals are merely endowed with an instinct which cannot help them to provide themselves with suitable or any clothing at all ; and hence they are supplied with a natural protection suited to their various circumstances and necessities—some with feathers, some with scales, others with hair and some others with a very thick skin.

330. Moreover the fact of man having been provided with no natural covering, while affording proof that he was intended to occupy all habitable parts of the globe, constitutes also a necessity which excites his ingenuity and skill to provide artificial covering and warmth, and through these to accommodate himself to every clime.

331. Clothing should be regulated according to climate, whether hot or cold, because in very cold countries, warm clothing is necessary for the maintenance of the natural heat of the body, and of the circulation of the blood, and other bodily functions. In warm countries, men's vestments should be both less and lighter, and this rule to clothe according to the temperature of a place, accords best with the natural inclinations of the inhabitants of that place. Accordingly, the people of cold countries encase themselves in leathern, woollen, and other warm garments, while the inhabitants of warm countries adopt clothings made of silk or cotton. And it

is remarkable that whatever kind of clothing may be needful in any country, such clothing is readily met with in that country. For example, wool, furs, and similar materials are abundant in cold climates and cotton, silk, and such like articles in warm climates.

332. Though the inferior animals are unable to clothe themselves according to the varying temperature of a country, a bountiful Providence has made a suitable provision for them. The animals which inhabit very cold countries are provided with a thick layer of fat beneath their skin, in order that no injury should accrue to them or to the functions of their bodies, and their natural heat should be maintained. In temperate climates, where cold is sometimes considerable, and at other times much less, in England for example, the inferior animals are not provided with an increase of fat to the same degree, but their skin is thick, and hair, long and woolly. In the winter especially, the hair grows longer, but when the cold decreases, it becomes finer and shorter; and if such animals be brought to a warm country, their wool falls off, and hair alone remains. The animals of warm countries not only have not the same amount of fat, but their hair also is neither long nor woolly.

333. It is requisite to regulate one's clothing according to season also. In the warm season, thin cotton or silk garments may be worn, but these should give place to clothing, larger in quantity and of thicker and warmer material, in cold weather. Especially when the season is changing, for ten or twelve days, special care is required to protect the body with adequate covering, and when the cold season commences, protection of the belly and the feet from exposure to cold is particularly advisable.

Inferior animals also, according to seasons, undergo certain changes. In winter their fat becomes increased, and their hair long and thick, while during the hot season the reverse occurs.

334. Clothing should also be regulated according to age. In infancy and old age it should be such as to afford increased protection to the body, because in those two periods of life there is a greater susceptibility of injury from cold and wind, especially during the changes of seasons. Children should be clothed very carefully according to season and temperature, especially at the time of taking them out into the open air. This is necessary in order to preserve their health and protect them from cold, coughs, diarrhoea, dysentery, and other diseases of the chest and bowels. These remarks with regard to the clothing of children are nearly applicable to that of aged people.

335. Too much stress can scarcely be laid upon the value of flannel as an article of clothing to be worn next the skin. Its advantages are,—that while it keeps in the animal heat, and prevents sudden chills, it allows of free cutaneous evaporation. Most people would do well to wear it in cold seasons. But those who are of delicate skin, and are peculiarly susceptible of taking cold from the slightest causes and who are therefore subject to frequent attacks of cold, coughs, diarrhoea, &c. should wear some soft fine flannel next to the skin both day and night throughout the year, if possible. They would most probably obtain from this simple expedient the relief from their troubles which no other remedy could afford them. Some individuals complain of the irritation it produces, but they seldom have the patience to give it a fair trial.

336. The arrangement of dress should be such as to admit of free and easy play of the limbs and different organs. No part should be unduly pressed upon by tightly worn clothes. Wearing wet clothes even for a short time is apt to produce injurious effects upon health.

CHAPTER VI.

EXERCISE.

337. THE necessity of exercise arises from the fact that the delicate machinery of the human frame requires a stimulus, external to the body itself, to keep it in healthy action, just as the finest and most self-acting machines, which man's ingenuity can invent, require to be kept in motion to prevent rust and injury.

338. Whilst it is true that inaction corrodes and rusts the lifeless machinery of the artisan, and corrupts and devitalizes the far more delicate organs of the human body, so also it is true that over-driving or over-exertion will certainly injure the well-being of the human frame as well as that of the machine. But there is this difference between the machine and the human body. Though over-driving may discompose or fracture the machine, yet, in most cases, repair may be possible, and a useful though imperfect machine may remain. But if the human mechanism be stretched too far, if the forces of body and mind be prematurely exhausted by over-exertion, nothing remains but a wreck,—a living death of the one, and a total overthrow of the other.

The Effects of Exercise.

339. *On the Lungs.*—The most important effects of muscular exercise is produced on the lungs. The circulation of the blood in the lungs is greatly hurried, and the quantity of air inspired, and of carbonic acid expired is marvellously increased.

340. Dr. Edward Smith has carefully investigated the first point and the following table shows the main results of his investigation. Taking the lying position as unity, the quantity of air inspired was found to be as follows:—

Lying position	1
Sitting	1 $\frac{1}{8}$
Standing	1 $\frac{1}{2}$
Singing	1 $\frac{1}{4}$
Walking 1 mile per hour	1 $\frac{1}{2}$
„ 2 miles „	2 $\frac{1}{2}$
„ 3 „ „	3 $\frac{1}{2}$
Walking and carrying 32 lb	3
„ „ 62 lb	3 $\frac{1}{2}$
„ „ 118 lb	4 $\frac{1}{2}$
Walking 4 miles per hour	5
„ 6 „	7
Riding and trotting	4
Swimming... ..	4 $\frac{1}{2}$

341. The great increase of air inspired during exercise is more clearly seen when it is put in this way. Under ordinary circumstances a man draws in 480 cubic inches of air per minute; if he walks four miles an hour, he draws in ($480 \times 5 =$) 2,400 cubic inches; if 6 miles an hour ($480 \times 7 =$) 3,360 cubic inches. Simultaneously the amount of carbonic acid in the expired air is increased.⁴ It was also ascertained that during the work-day about 3,800 grains or 8 $\frac{1}{2}$ ounces of oxygen were absorbed in excess of the rest-day and that 5,750 grains or 13 ounces in excess of carbonic acid were evolved.

342. Inaction is particularly detrimental to the function of the lungs. A person sitting at a desk, or standing all day behind a counter scarcely breathes one-half of the amount of air which he ought to do. The pulse sinks to the lowest ebb, and the respirations are so gentle and superficial, that frequently not more than eight or ten, instead of twenty or thirty cubic inches of air enter into the lungs, and are changed, at each breath. No wonder that such persons feel towards the close of the day so much languor and lassitude and depression of spirits. If they are wise enough to go out for a little while and breathe the pure air outside as soon as those feelings make their approach, say in the middle of their business, and again at the close of it in the evening, to take a brisk walk of a few miles in the open air, the mind will regain its tone and cheerfulness, and life, which an hour before seemed an intolerable burden, will now be filled with hope and cheerful enjoyment.

343. *On the Heart and Blood Vessels.*—The action of the heart rapidly increases in force and frequency, and the flow of blood through all parts of the body, including the heart itself, is augmented. The amount of increase is usually from ten to thirty beats, but occasionally much more. For instance, if the heart beats about 70 times per minute while in a state of quietude, a good muscular exercise will increase the action of the heart to about 100 beats per minute. •

344. Whether we be carried rapidly through the air on horse-back, or in a carriage, exciting thereby the respiration, or take a brisk walk, ascend a hill, or use gymnastic exercise, or play upon wind instruments, or bathe and rub the surface of the body until it becomes red and warm, in each of these cases the ultimate effect is the same, though obtained in

various degrees. The blood is equally diffused throughout the whole body, the congestion of any weak part is relieved, the brain especially, being supplied with purer blood derived from the oxygen inhaled, acquires freer powers, the spirits become more elastic, the tone of mind more cheerful, and hopeful, and courage—that peculiar compound of animal well-being and force of character—rises to its highest pitch. All these effects are derivable only from an equable and vigorous circulation of pure blood throughout every organ of the body.

345. After exercise, however, the heart's action falls below its normal amount; and if the exercise has been exceedingly prolonged and severe, may fall as low as fifty or forty beats per minute, and become intermittent. The ascension of heights greatly tries a fatigued heart. Excessive exercise leads to palpitation of the heart, and sometimes (though rarely) also certain dangerous affections of that vital organ. These may be avoided by careful training and a due proportion of rest after exercise. Injuries to blood vessels may also result from too sudden or prolonged exertion.

346. Deficient exercise on the other hand leads to weakening of the heart's action, and probably to dilatation and fatty degeneration of that organ.

347. *On the Skin.*—During exercise the skin becomes warm and perhaps red from its blood-vessels becoming turgid, and perspiration is increased; water, certain salts, and acids pass off in great abundance. The exact amount of fluid passing off is not certain, but is very great. Experiments show that the ordinary quantity of perspiration is at least doubled and trebled under conditions of exertion.

348. *On the Muscles.*—The muscles grow and become harder under the influence of exercise. All organs increase by use within natural limits, and diminish and collapse by inaction. The well developed mus-

cles of the blacksmith, the sailor, and others who use great muscular exertion, testify to this common truth.

349. It seems*to be a fact, however, that prolonged exertion, without sufficient rest, damages to a certain extent the nutrition of the muscles, and they consequently become soft and weak.

350. *On the Nervous System and the Brain.*—Considering that perfect nutrition is not possible except with bodily activity, we should infer that sufficient exercise would be necessary for the perfect performance of mental work. Deficient exercise causes a heightened sensitiveness of the nervous system, a sort of morbid excitability, and a greater susceptibility to the action of external agencies.

351. *On the Digestive System.*—The appetite largely increases with exercise. Digestion is more perfect, and absorption more rapid. Food must be increased, especially nitrogenous substances, fats, and salts. The effects of exercise on digestion are greatly increased if it be taken in the pure open air, and it is then a most valuable remedy for some forms of dyspepsia. Conversely, deficient exercise lessens both appetite and digestive power. Due amount of exercise exerts a valuable influence upon the bowels as well as other excretory organs in maintaining and promoting the performance of their functions, and thus freeing the system efficiently of the effete and noxious matters.

352. Want of exercise as we have now seen is attended by a languid condition of the circulation, diminished muscular power and a weak flabby condition of muscles, undue nervous excitability, and a sluggish discharge of the functions of the

various organs of the body. Those, who while taking insufficient or no exercise, also commit excesses in diet, are very apt to become congested and corpulent, and the fat that individuals frequently accumulate from such causes is by no means indicative of good condition. Hypochondriasis, hysteria, and other nervous affections are most common and severe among the indolent and inactive.

353. Of the North American tribes, some subsist by fishing, others by the chase ; the former, from leading a comparatively sedentary life, are of low stature, given to obesity, and not remarkable for muscular strength ; while the latter are tall athletic vigorous men, with powerful muscular limbs, and owe their fine physical development to early habituation to the chase and other invigorating pursuits.

354. No doubt the legislators of ancient Greece in planning and introducing the Olympic games were well aware that, by encouraging and fostering them, they were developing the health and bodily vigour of their youth, inuring them to deeds of daring and feats of strength calculated to be of immense service against their enemies in the field of battle, at the same time that the national courage and pride of race were thereby heightened and confirmed.

Exercise of Students, Literary men, &c.

355. A gentleman employed in a public office or bank, a police-magistrate or judge who passes many hours of each day on the Bench, the editor at his desk, or any other person whose occupation is sedentary and inactive as regards the body whilst the intellect is kept in continual activity, requires that the brain should be supported by an afflux of blood to it in due force and velocity, without which the power of judging will fail, and the attention necessary for

continuous thought will flag. Except in persons of very strong powers, this derivation of the blood to the brain and nervous centres, withdraws it in some measure from other parts of the body. Not only do the extremities become cold and numb, but the internal organs suffer from loss of their fair share of blood. From this cause the appetite and digestion fail, although a craving for support may be felt. Towards the close of the day's work, the brain becomes exhausted from over-stimulation, and the blood begins to stagnate there also. The brain substance ceases to be renewed, and now mental as well as bodily exhaustion supervenes. At the usual hour he rises from his desk and finds himself quite tired and weak, almost feeling the burdensomeness of life. But if he is a wise man he can easily get rid of these unpleasant sensations by employing the simplest of nature's means. If he takes a brisk walk homewards or a ride in the Park or towards his suburban villa, the headache or exhaustion which oppressed him when he left his office is removed ; and by the time he arrives at home and sits down to dinner he has acquired sufficient appetite and power to digest his food and again to engage in lighter mental occupation in the evening without injury. How does this come about ? Simply by changing the current of the circulation. The blood, which during the long inaction of the body stagnated in its lower parts whilst it coursed too rapidly through the head, by active exercise and the pressure of the muscles upon the veins, is forced onwards towards the heart stimulating that organ to more rapid contraction in order to pass the blood through it. The venous system, being thus assisted in propelling onwards the blood, makes less demands upon the heart's force, and thus the rapidity of the circulation is increased whilst the heart is less embarrassed. So long as this organ remains sound, and the nervous energy is unexhausted, these good effects will be certain to follow from active exercise taken in due quantity and at the proper time.

356. *Students.*—It must be plain to every one that the whole hopes, prospects, everything dear to the student, must depend upon his health. If the powers of the body be palsied or prostrated, or in any way abused, his mind must so far sympathise as to be unfitted for making progress in study. If the health of the student be gone, he is at once cut off from doing anything by way of study. The mind cannot, and will not accomplish anything, unless he has good health. He ought therefore to resolve that, at any rate, so far as it depends upon himself, he will have the *mens sana in sana corpore*.

357. It is frequently the case that the student, feeling strong in the buoyancy and elasticity of youth, sits down closely to his books resolved to stop for nothing till his scholarship is fair and high. The first, the second, and the third admonitions, in regard to his health, are unheeded, till at last he can study no longer, and then, too late, he discovers that the seeds of death are planted in him. The more promising the student, the higher are his aims, and the stronger are the aspirations of his genius, the greater is the danger. Multitudes of the most promising young men have found an early grave, not because they studied too intensely but because they paid no attention to their health. Another cause why so many of our promising young men sink into a premature grave, is that they try to do so much in so short a time.

358. Many students do not at present feel any necessity of exercise. But it is not at their option whether they will take exercise or not ; they ~~must~~ take exercise or they are lost to all their hopes and all their prospects. There are others who plead that they are pressed for time and therefore they cannot take exercise. These must be made aware that they miscalculate on one important point. If they will try the plan of taking regular vigorous exercise every day for a single term, they will find that they can perform the same duties

and the same amount of study much easier than without the exercise. The difference will be astonishing to themselves. The time spent in thus invigorating the system will be made up, many times over, in the ease and comfort with which their mind takes hold of study.

359. Ancient philosophers, Plato and Aristotle in particular, laid great stress upon the twofold constitution of man, and the necessity for striving to acquire physical as well as mental perfection. Plato makes gymnastics play a prominent part in his model republic, and even speaks of a man as being a cripple, who attends only to the cultivation of the mind, and suffers the body to become enervated from inaction.

360. No student is doing justice to himself, to his friends or to the world, without being in the habit of a uniform system of exercise, and that for the following reasons :—

361. 1st, his life will probably be prolonged by it. It is little less than suicide to neglect to take proper and regular exercise without which he must almost certainly shorten his days. The Creator has not so formed the body, that it can endure to be confined without exercise while the mind burns and wears upon its energies and powers every moment.

362. 2nd, his mind will be strengthened by exercise. If he wishes for a mind that can fearlessly dive into what is deep, soar to what is high, grasp and hold what is strong, and move and act among minds, conscious of its own strength, and firm, resolved and manly in its aims and purposes, he must be regular in taking daily exercise.

Exercise of Children and Youth.

363. In childhood—when the whole body is yet plastic and may be moulded either to physical weakness or strength, a due amount of exercise is of the utmost importance, tending to the development of the chest and other parts of the frame and to the promotion of muscularity and vigour. There can be no greater or more fatal error than that constantly com-

mitted by some parents, who, in their too great anxiety for the mental progress of their children, keep them daily, for hours together, in stiff constrained positions, engaged in the pursuit of knowledge. Study in the young should be frequently relieved by relaxation and exercise more or less partaking of the character of games or play.

364. At the present day, in all best seminaries in Europe, what are called calisthenic exercises have been introduced, and a good deal of bodily exercise is obtained. But the great vice of most of the schools of this country and especially of the indigenous pial schools, is that the hours of study, at one stretch, are by far too long. The natural condition of the young of all animals is to alternate active exercise with repose at very short intervals. Work and play should be alternated several times, not once only, in the day. If a period must be fixed, we may say that three hours is the utmost that boys should be confined to the school-room at one time (two hours and a half is much better) and much less, say two hours, for girls. All boys' and girls' schools should possess a large play-ground, where all sorts of suitable games might be carried on.

365. The best kind of exercise for all boys, that is, those between the ages of 7 and 16, are games. Walking, so valuable for older people, is not sufficiently exciting for youths under 18. Games of various kinds put into action almost every muscle of the frame; but those of the limbs, of the back and chest, should be exercised the most. The joints should be kept in constant action, whereby the bones will be strengthened and the circulation quickened in every part of the body.

366. The exercise of girls should partake somewhat of the character of that allowed to young or weakly boys. The skipping rope is, out of all comparison, the finest implement that can be placed in the hands of young girls. Skipping

calls into exercise almost every muscle of the body, the muscles of the arm, those of the chest, of the whole length of the spine, with those of the thighs and legs, are all nearly equally exercised. The ropes for climbing and raising the body by the arms are also excellent for girls.

367. Stronger boys are very apt either out of emulation or bravado, to test their physical powers to the highest point. Incalculable mischief is frequently produced by this practice. Boating when done against time and long and violent runs are exercises of this dangerous character. It is not that the muscular system is overtaxed, but the extreme excitement of the circulation so tries the powers of the heart, that its fibres may be injured, and permanent disease result. Several instances of this melancholy wreck of the vital powers are recorded as the result of rowing and running matches.

368. In the case of delicate and nervous children, and of those whose muscular development is small, or whose tissues are soft and flabby, we must begin with the gentler exercises, proceeding, by very gradual steps, to those which require more strength of muscle and longer continued attention. By proceeding thus carefully, perseverance will be rewarded by converting the puny and delicate child, in a few months, into a robust, firm, and active youth. The intellect will gain strength at the same time, and although the quickness natural to delicate children may be somewhat dulled, the increased power of sustaining the attention upon any subject will more than compensate the loss of the more showy but less durable quality.

Kinds of Exercise.

369. Exercise is usually described under the heads of passive and active:—the former being that kind in which the movement is effected by other instrumentality than our own; the latter that in

few hours into the country away from our usual place of residence, or they may be carried on for several days or weeks over country replete with natural beauties and historical associations. Such periodical intercourse with nature, if not attended with undue fatigue, is productive of the highest benefit. To the body and mind which have been cramped by noxious work or company, nature is medicinal and restores their tone.

376. One will derive additional enjoyment and advantage from his walks, if his mind be imbued with a keen appreciation of the sublime and beautiful, and, if in addition, he have some taste for one or other of the natural sciences. The society of an intelligent and sympathising friend also materially enhances the pleasure of this kind of recreation. The influence of periodical intercourse with nature, unlike that of most worldly and sensual gratifications, is not transitory. These images conveyed through the eye to the brain, and through this to the mind, are not lost : they remain, become part of our intellectual being, and furnish food for the imagination, and memories pleasant to dwell upon,

377. Exercise should be regular and systematic. Exercise is beneficial or pleasant in proportion to its regularity. We should be as regular in taking exercise as we are in taking our food.

378. There is an error of a seductive character which prevails, especially amongst young men. It is their belief that a short period of very active exertion, the use of dumb bells, gymnastics, boating or hard walking against time, will compensate them for inactivity for the remainder of the twenty-four hours, and even for several days. Here speed is not the equivalent of time. That is to say a great amount of force excited over a very short period is by no means equal in point of

salubrity to a smaller display of power carried on for a longer period. This principle obtains throughout the whole animal economy. The fast coach-horse, going twelve miles an hour once in the day, is knocked up in a year or two, whilst the cart-horse will walk forty miles a day, four miles an hour, for many long years, working to the very end. There are no lasting effects in the organic world without length of time in the production. All violent efforts are followed by exhaustion, not only of the part exercised, but also of the whole of the vital forces.

379. Exercise ought not to be taken when the system is empty, nor immediately after any meal except it be a very light one.

380. A mere lounge or stroll, for a short time or distance, is not to be regarded as exercise; walking, to be beneficial, should involve effort, and result in free action of the skin, and through this and increased respiration, in the removal of noxious matters from the system.

CHAPTER VII.

SLEEP.

381. THE necessary consequence of continued physical and mental exercise is exhaustion of nervous power, for the restoration of which, sleep is necessary.

Towards the close of a day spent in laborious duties, the muscular system loses its force, the mind can with difficulty direct its attention to different objects, the senses become blunted, drowsiness supervenes, after a while eyelids close, and that state of unconsciousness is established, which constitutes sleep.

382. An individual, when in sleep, is usually so still and motionless, that we might consider him dead, were it not that his skin is warm, his heart still beats, and his breathing continues. After lying in this state for a time, generally for several hours, insensible to all that is going on around, he again opens his eyes, moves, collects his thoughts and when fairly awake feels his various faculties refreshed and invigorated and ready again to cope with the duties and difficulties of everyday life. The thread of existence is, as it were, resumed at the point at which it was lost on falling asleep, and ordinarily there is no recollection of any thing having occurred in the period during which sleep continued. Occasionally when this is not very profound, a certain degree of mental activity is evidenced by sundry twitchings and startings, by muscular movements, at times by the sleeper talking, or even by his getting up and moving about; and when he again awakes, he has either a faint or more or less distinct remembrance of what his mind was doing while he was asleep.

383. The ideas that arise in the mind during dreams, may be sufficiently vivid to excite into action the organs requisite to express them, or carry them out. In this way may be explained the fact that certain persons talk coherently in their sleep, and that others sing, and frequently with more precision and power than when awake, because they are not disturbed by impressions from without. In this way the phenomena of somnambulism may be accounted for. The sleep waker, under

the exciting influence of certain ideas, gets out of bed, leaves his room, or even his house, makes his way to a certain point, performs certain acts (his course all the while accurately directed by his sense of vision), returns to his bed, and again sinks into profound slumber.

384. In certain states of dreaming, the influence of the will is entirely lost, but ideas spring up in the mind which are evidently prompted by impressions made from without upon one or other of the senses. A load of undigested food in the stomach may give rise to various forms of night-mare; a draught of cold air playing upon the body may cause a person to dream that he is bathing or drowned in the sea in a cold cheerless day; a bright light, suddenly brought into contact with the retina through the closed eyelids, may cause him to dream that the house is on fire. Dr. Abercrombie relates the cause of an individual who dreamt that he was in the din and tumult of battle; on awaking he found that the charge of artillery which had half deafened him in his sleep, was nothing more than the noise caused by the fire tongs having fallen down in the fender.

Quantity of Sleep.

385. Deficiency of sleep induces exhaustion and undue irritability of the nervous system, imperfect discharge of the various functions, impaired appetite and digestion, and, in consequence, emaciation and loss of muscular power. The frame becomes gradually weaker, and sinks for want of the usual renovating influence. Endless are the ways in which man's ingenuity has been taxed in devising punishment for his fellow-man; but we can scarcely conceive a severer penalty than that which was visited on Perseus, king of Macedonia, who, on being taken prisoner by the Romans, is said to have been put to death by never being allowed to go to sleep.

386. Undue indulgence in sleep is also productive of the most injurious effects. The mental faculties become more or less paralysed, the body loses its vigour and power of resist-

ance, functions are torpidly discharged, and if the abuse be associated with excesses in diet, fat accumulates to a great extent, and the man degenerates into a huge animal. Not only is time directly lost by spending too many hours in bed, but the body and mind, when in the waking state, are less fit to work than they should be.

387. No absolute rule can be laid down in reference to the amount of sleep that is necessary or healthful. It will, of course, vary with age, strength, the amount of fatigue that has been sustained during the day, habit which is in this matter pre-eminently a second nature, and other circumstances.

388. The average quantity of sleep, as applicable to the wants of the majority of grown up persons, may be stated as six or seven hours. Less than this does not suffice to thoroughly recruit the wasted powers of very actively employed people; and more can only be required in exceptional cases.

389. Children, buoyant and ever revelling in the enjoyment of developing power, soon become exhausted, and require longer and more frequent repose. In the prime of life, when the functions are vigorously performed, and great physical and mental exertion is habitually practised, six or seven hours of continued sleep, in every twenty-four hours, are required for the restoration of the wearied frame. In old age, when nervous irritability is subdued, and the exertion undergone is but slight, and the activity of the different functions is diminished, a comparatively small amount of sleep is sufficient.

390. Children should be allowed a larger quantity of sleep than adults, in proportion to their growth. Up to six or seven years of age they require ten or

twelve hours daily ; from this age to fourteen or sixteen, eight or nine hours may be allowed, and so gradually diminishing to six or seven hours.

391. Among women those who have the cares of a family, and perhaps the duties of child-bearing and nursing, in addition to the daily routine of the household to undergo, require more sleep than men. They may take an hour extra with advantage ; but ladies in society, and young females employed in in-door labour, frequently take less sleep than men.

392. But it is the nature of a man's employment which must determine the quantity of sleep. Those occupations which are conducted in the open air are not only most conducive to sleep, but also require the largest quantity of it. The day labourer goes to bed at nine or ten, and sleeps soundly till five or six. His repose is made sound by the severity of his toil. The great amount of change which goes on in his system, from muscular exertion, demands a corresponding degree of functional repose.

393. The sedentary citizen, on the other hand, making use of but little bodily exertion, and changing the tissues of his body more slowly, sleeps less, and that less soundly than the countryman. Six or seven hours' sleep often suffices for the artisan, and domestic servants. But very often the more leisured classes and the luxurious, indulge in a longer term of repose ; but their sleep is more broken and disturbed, and therefore less refreshing than that of more active persons. Those who are of active habits generally take less sleep than the lazy, but their slumbers are more profound and refreshing.

394. Work of the brain, especially study, is more exhausting to the vital powers than manual labour, and, to be successfully conducted, requires a large amount of sound sleep. There is great variation, however, in this respect amongst literary men, and others whose minds are on the stretch for a great many hours daily. Such persons should cultivate sleep, when hard-worked, snatching an hour whenever it can be got. It is astonishing to notice the relief which even ten minutes' complete oblivion will give to the jaded mind after any great strain upon it. The same is not true with regard to mere physical fatigue. In this case, sleep should be deferred until the regular period for rest, and then, if required, an extra quantity may be taken ; a short sleep only stiffens the joints and causes great languor and feverishness.

395. Persons recovering from long or severe illness must be placed in the same category with young and growing people, and for the same reason. The nutritive powers assume an increased activity to supply the waste of the body caused by disease. Seven or eight or even more hours' sleep are often demanded under these circumstances.

Proper Time for Sleep.

396. In selecting the period for repose, it is best to attend to natural indications and avail ourselves of some portion of the night.

397. Those who turn night into day, and pass the hours that should be devoted to rest, in the study, or the fashionable assembly, justify their proceeding by declaring that it signifies not, at what time sleep is taken, so long as the system gets as much as it requires. Nature however testifies against these men. The exact correspondence of the activity of vegetation with the quantity of light, and the manner in which the inferior animals follow the course of the sun in their habits of sleeping and waking, prove that there is a natural and necessary connexion between day-light and work, and darkness and sleep.

398. Those who infringe the laws of nature in respect of time or quantity of sleep will assuredly find their health sooner or later impaired in consequence, and will be paler and more enervated than those who retire betimes, and "rise with the lark."

399. The blanched condition of such persons may be the result of deprivation of the vivifying stimulus of the sun's rays. A distinct advantage is gained by working in the early morning in preference to late at night, from the fact that day-light is far less trying to the eyes than the artificial light of a lamp or candle. The man who habitually rises early will enjoy greater health and vigour, have more time for the various duties of life, in all probability be more prosperous in his career, and thus realize the adage that,

Early to bed, and early to rise
Make a man healthy, wealthy and wise.

400. For those who live in the country, a further attraction in early rising is offered in the freshness and beauty that usher in the dawn of day. How charming is the early morning, especially in a dry season? How the spirits rise, and the body craves for action when stimulated by the fresh sharp air of that period of the day? Who that has ever been compelled to rise very early, say at four or five o'clock on a bright morning, but has wished he could always do the same thing?

Circumstances Conducive to Sound Sleep.

401. The condition of the body exercises a great influence, good or evil, upon the chances of obtaining sound sleep. The stomach should have completed, or nearly completed, digestion. Yet too long a time since the last food was taken should not be allowed to elapse before bed-time, or the want of

sustenance in the system will cause, especially in weakly persons, a feeling of exhaustion and sinking which is antagonistic to sleep. Many persons rest better after taking a little supper a short time before going to bed.

402. It is unnecessary to descant upon the condition of mind most conducive to sound sleep. As this happy state cannot always be secured, it is well to know what devices to have recourse to, in case of restlessness from mental causes. If the mind has been over-excited by amusement or important business, which is generally performed in heated apartments, a stroll for half-an-hour or more in the cool air outside will be the best course. For those who cannot do this, recourse may be had to a total change of thought, such as may be procured by laying aside the object of study, and reading an amusing book for a little while before seeking rest. Or, in the worst cases, we must try to read ourselves to sleep in bed. If all this will not do, it is better to rise and set about some occupation, leaving the hope of rest until the following night, when the utterly jaded frame will succumb to the over-whelming necessity for sleep. If sleep be prevented by an over-distended stomach with flatulence, a common thing after late dinners, some of the common remedies for this state must be taken before retiring to bed.

403. After all, the proper way of obtaining the blessings of sound sleep is to attend to the teachings of nature as regards the management of health generally, instead of depending upon artificial means of whatever kind. Foremost amongst these, must be placed early rising. Regularity in the hours of meals and of retiring to rest, and also in the quantity of food taken in the twenty-four hours, is the second highest means of procuring sound sleep. Thirdly,

plenty of exercise in the pure open air is a powerful means to effect the same end. Lastly, the satisfaction of mind which arises from the consciousness of having honestly and honorably performed every appointed duty of the past day—never putting off till to-morrow what can be done to-day—must be reckoned not least in the list, for it is the most blessed of all, insuring, as it does, the approbation of our own conscience, and the tender fatherly and motherly care of the All-Beneficent One, “for so He giveth His beloved sleep.”

404. The bed-rooms should be thoroughly ventilated in order to ensure a sound sleep. Vide sections 48—50. The greatest care should be taken that the bed-clothes are well-aired when they are first put on, and a sort of airing or ventilation of them should be effected daily by throwing them off the bed on getting up in the morning, and letting them remain off and exposed to the air for the greater part of the day.

405. The most distressing conditions of the mind during sleep are referable to impressions made upon the sentient nerves either of the surface of the body or of some internal organ, and conveyed through these to the brain. It is important, therefore, to obviate these as far as we can. We should seek to render our position when in bed as easy as possible, and to avoid undue pressure upon any part of the body. Lying on the back is objectionable, and is apt to induce unpleasant dreams; it is better to recline on the side. Disturbing influences in the shape of noises, bright lights, draughts of air, &c., are to be avoided, as being likely either to prevent us from going to sleep, or to cause annoying dreams.

CHAPTER VIII.

HEALTH OF MIND.

406. FROM the intimate sympathy that exists between the mind and body, it follows that a due regulation of both is necessary to perfect health. There are many ways in which the mind exerts an influence, either prejudicial or favourable, upon the different functions of the body.

407. While, on the one hand, a sound condition of the body is essential to the health of the mind, and the development of this cannot be ensured, or its vigour maintained, if the body be weak, puny, or suffering, and the physical functions inadequately discharged, so, on the other hand, a badly regulated condition of mind is prejudicial to physical welfare.

408. We should be cautious at what period of the day we engage in intellectual pursuits. The immediate effect of intense mental action after meals is to interfere with the process of digestion; and the custom of doing so habitually may give rise to chronic dyspepsia. The effect of mental exertion, late at night, is to induce irritability of the brain, and interfere with the refreshing action of sleep.

409. Another result of excessive mental effort is, to induce undue determination of blood to the head, and give rise to headache, and confusion of ideas; and if such abuse of the mental faculties be habitual, permanent congestion, or disease of the brain, the organ through which the mind acts, may be induced, and the foundation laid of that most fearful of all conditions—mental aberration.

410. The degree and kind of intellectual exercise will, of course, have reference to the powers of each individual, and to the period of life. It would be impossible to conceive any

practice more prejudicial to the future health of both mind and body, than that of forcing the intellectual development in infancy and childhood. Instead of confining children within doors during the greater part of every day, cramming their minds with the lifeless material of spiritless class-books, and thus endeavouring to produce prodigies and precocities, we should take care that much of their education is conducted out of doors, so as to provide for physical development and health, while we ensure expansion of the mind and heart by directing the attention to the minor beauties or broad effects of nature. Where a child exhibits any unnatural excitability of mind, we should use the utmost caution not to increase it and induce disease by forcing the mental powers.

411. Instead of trying to repress its mental activity, the fond parents misled by the early promise of genius, too often excite it still further by increasing cultivation and the never-failing stimulus of emulation and praise, and finding its progress for a time equal to their warmest wishes, they look forward with ecstasy to the day when its talent will break forth and shed a lustre on its name. But, in exact proportion as the picture becomes brighter to their fancy, the probability of its being realized becomes less; for the brain, worn out by premature exertion, either becomes diseased, or loses its tone, leaving the mental powers slow and depressed for the remainder of life. The expected prodigy is thus ultimately and easily out-stripped in the social race, by many whose dull outset promised him an easy victory.

412. The system of carrying on mental education at the expense of the body in boyhood and youth which prevails to too great an extent in this country, is much to be reprobated. If the study of the natural sciences were to occupy a more prominent place in different educational systems, the vigour of the body would be more effectually promoted, and the mind would

acquire greater energy and breadth. The student, in contending for honours, will more certainly realize his object by habitual attention to the laws which regulate his physical being ; and among other sanitary practices, a brisk constitutional walk for an hour or two every day, will prove advantageous to him. Excessive study, during the years of youth, tends to debilitate the frame, and retard its due development ; while the mind itself becomes weakened by over-action, and, by concentration on certain objects, is deficient in the comprehensive grasp which it would acquire by healthful intercourse with nature and the world. It is not too much to aver, that the exclusive unnatural course of life pursued by many students, incapacitates them for future energy of either body or intellect.

413. The most prominent defect in the education of children and youth in this country is the utter neglect of knowledge of objects. Many and most deplorable are the consequences of this neglect. To satisfy the craving of the mind for objective knowledge, it is evident that the senses and perceptive faculties ought to be early educated to observe and to distinguish—yet how little is this principle recognized in the education of the young of this country. In the first years of life, the acquisition of a knowledge of objects is all that the infant can accomplish. On beginning school, however, his attention is almost completely withdrawn from natural objects. Grammar and languages, mathematics and other abstract studies, occupy all his attention, and his knowledge of natural objects and processes remains, at the time of leaving school, pretty much as it was on entering it. The curiosity is never aroused, and there are literally no opportunities for its gratification.

414. The reason why so many people of this country take little or no interest in the study of natural history, is the neglect of object culture in early years when the eyes are

not taught to see, the ears to hear, nor the sense of touch to feel. The consequence is that, in after life, nothing is so common as to find educated people unable to describe the qualities of the commonest natural objects with precision, or even to detail with accuracy an event which has passed under their own observation.

415. This exercise of the perceptive faculties by the study of natural science would also prove the best safeguard against the prevailing superstitions and impostures, which owe their immunity from detection and exposure to the absence of the faculty of observation amongst the so-called educated men. The sad spectacles of credulity exhibited by the victims of the superstitions and impostures relating to demons, magic, witchcraft, &c., would be cured by even a tolerable smattering of the knowledge of the phenomena of natural sciences.

416. Moreover an acquaintance with the realities of nature would explain those phenomena of morbid sensation and perception, which persons afflicted with them are credulous enough to believe, or dishonest enough to pretend to believe, to be the manifestations of supernatural powers or gifts. A competent knowledge of the unvarying sequence of natural phenomena, of the unerring relation of cause and effect, and of the impossibility that man can receive any communication from another world except by the special interposition of the Deity, would make people ashamed to know the silly and shallow devices by which they are now imposed upon.

417. Again how many men of business there are, who find their leisure-time hang heavily on their hands for want of some definite object of intellectual pursuit; this would not be the case, if they should acquire some tolerable knowledge of natural sciences in their early years.

418. *Cultivation of Moral Faculties.*—With reference to

their effects upon the health of the mind, the moral and social sentiments may be divided into two classes; viz., the Exciting and the Depressing Emotions, or Passions. By the first, we mean those emotions and desires from which the active or volitional powers take their rise. Such are emulation, ambition, patriotism, in their application to society and the world; and the more personal emotions of joy, hope, love, which are partly passive, and partly active in their nature. All of these propel the moral force in a forward direction. They may be called transitive emotions, because their operation does not rest upon the individual who is the subject of them, but passes on to an object which may be one of desire or of love. They are essentially progressive in their tendency; looking forward is their characteristic quality, and hope is their basis.

419. The depressing passions, on the contrary, seem to be reflective or non-transitive in their nature. They chiefly concern the individual himself, and may arise and subside in the mind, yea, even dominate over its more active qualities, giving a colour of their own to the whole character, without their existence being known by any volitional exercise: such are pride, conceit (as distinct from vanity), fear, sorrow, despair. All of these depress the powers, both of body and mind, by their restraining action; and there is great reason for believing that this is effected by their sedative action upon the heart, whereby less blood than usual is sent to the brain, and the evolution of nervous force diminished in consequence. Their effect upon the individual is to wrap him up in a false appreciation of his own importance; and he gets angry with the world for not evincing the same high estimate of his abilities or worth as he has himself formed of them. Some of them, such as fear

persuasion that every man's hand is against him, and that he is not made for success.

420. The cultivation of all the moral faculties, with the affections and desires, is entirely necessary to the well-being of man. They have all their proper office to subserve in the economy of the world.

421. The present has been called the age of hurry : it is also one of worry. Material wealth has acquired such a preponderating influence as to attract towards its attainment all the faculties of the mind, until the means are confounded with the end ; and the appreciation and taste for the pleasures of the intellect and of active benevolence are wasted and lost in the excitement of the race after rank and fortune which are too often only attained when they can be no longer enjoyed. Strong minds are continually sacrificing their legitimate enjoyment to what they consider the paramount claims of wealth or ambition. Concentration of effort, though perhaps essential to perfect success in any calling, is prejudicial to the mind as a whole. Very successful men are rarely amiable ; they have shown so little consideration for the rights and claims of others, in the long struggle for precedence, that they come to look upon their own interest as the mainspring of their actions, and to see justice and courtesy only when they are placed in a direct line with the goal towards which they are bound. They are, moreover, envious and jealous ; feeling that they are obliged to hold on to the upper rounds of the social ladder for dear life, lest they should be plucked off by those who are squeezing and pressing below.

422. Now, it is this concentration of the mind towards one set of ideas, one object of desire, which is frequently followed by that miserable break-down which often at the very moment of fruition, afflicts the devotees of a mistaken ambition. Softening of the brain, and its accompanying paralysis of bodily and mental power, or, if not so

bad as that, shattered health, ennui, and listlessness mark the irreparable injury which all the powers have received from the prolonged strain upon them.

423. There is another way in which this ruling passion tends to disorder the true balance of the moral sentiments and contributes to swell the heavy and increasing list of acknowledged and unacknowledged aliens from mental health. The world, it is true, worships success, and is not over-nice to mark the means by which success is attained. Comparatively few, however, of its devotees are happy. Every now and then a sudden flash of conscience suffuses the surface of the mind, which, like blushing, is a painful feeling. There are recollections of unfair means used, of too sharp practice, and of the suffering cry or look of those who have been rudely pushed aside in the race, which give many a stab of anguish in the still hours of nocturnal reflection.

424. Again that state of mind which is often induced by want of success (and from the nature of things it must happen to many) whether from inferior ability, want of opportunity, or the unfair conduct of others, is generally of an unhealthy character. An abiding sense of injustice is pretty certain to lead to envy, hatred, and a desire for revenge, passions which disturb the healthy balance of the mental functions more, perhaps, than any other. The domestic affections are passed by unenjoyed, because they are not sweetened by the pride of place or wealth; and apathy and indifference to the best feelings of our nature, contempt of the world and its objects, fall like a funeral pall over all the faculties both of mind and soul.

425. From the foregoing observations we can easily understand how a moderate action of many of the moral emotions of joy, hope, love, &c. imports a healthful stimulus to the functions of the body and mind, though, if not duly controlled, they are apt to induce derangement of them; and how

depressing and baneful in their action are, fear, sorrow, care, pride, envy, hatred, &c. It is in the power of the enlightened religious principle to afford the best aid in enabling us to resist undue influence of the depressing and hurtful passions. In conclusion, it is enough to say in reference to this branch of the subject that a due regulation of the moral affections, no less than of the intellect, is indispensable to health.

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